DIAGNOSIS OF SMALLPOX

Volume I (Text)

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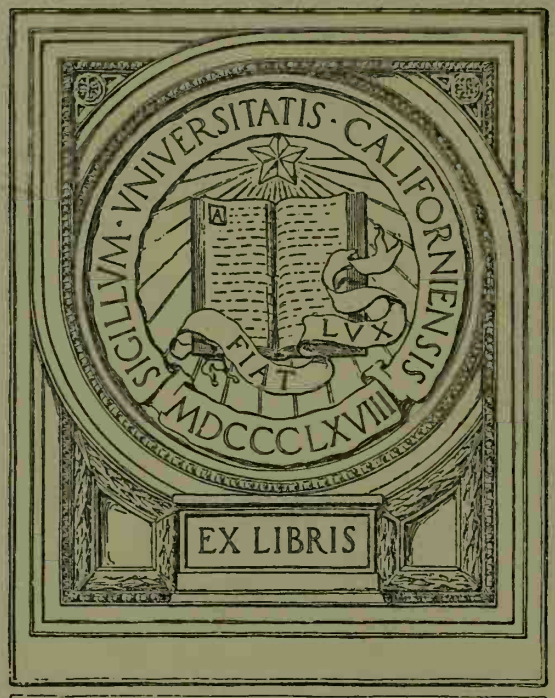

VOLUME I (Text)

THE DIAGNOSIS OF SMALLPOX

by THOMAS FRANCIS RICKETTS, M.D.
B. Sc. (Lond.), M.R.C.P., D.P.H.
MEDICAL SUPERINTENDENT OF THE SMALLPOX HOSPITALS
OF THE METROPOLITAN ASYLUMS BOARD

ILLUSTRATED FROM PHOTOGRAPHS BY
JOHN BEUZEVILLE BYLES
M.B. B.C. (Cantab.), F.R.C.S. Eng., D.P.H.
SENIOR ASSISTANT MEDICAL OFFICER AT THE SMALLPOX
HOSPITALS OF THE METROPOLITAN ASYLUMS BOARD

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FOREWORD
TO THIS REPRODUCTION

"Could this be smallpox?" If this question occurs to the first physician seeing a case of severe prostration or acute skin eruption in a person who within 2 weeks has been exposed to travelers or to hospital personnel, half of the danger from smallpox would be averted. Illness of any sort in a person recently returned from an area where smallpox is endemic or in one who may have had contact with such a person, should be a cause for suspicion.

But raising the question is not enough. A prompt and correct answer must be given. Laboratory confirmation is customarily too slow for effective vaccination of all contacts. Current textbooks and treatises on smallpox are helpful but inadequate. It is not enough to have seen cases.

Thomas F. Ricketts probably had the richest experience with the disease and used it to the best advantage of anyone in the world's history. London was then the largest metropolis. Cases of smallpox there were hospitalized in an institution under the direction of an able and conscientious board with a diligent and permanent medical

staff. Vaccination had been opposed and neglected. Consequently, 15,683 cases of smallpox, 13 percent fatal, came under Ricketts' care and observation, together with 1,367 cases of other conditions diagnosed as smallpox and committed to his isolated hospital; 140 of these 17,050 are pictured in the book, and there are 34 additional photographs of the same patients; all were originally in clearer detail than in other books on smallpox. For 15 years Ricketts had compared the relative value of the different diagnostic criteria. Subsequently (Bulletin of Hygiene, 1948), in a study of 13,686 cases of mild smallpox (variola minor, with a fatality of ¼ percent, 0.14 percent due to smallpox), J. Pickford Marsden found Ricketts' methods of diagnosis absolutely valid.

The plates to illustrate the text were selected by Ricketts from the largest collection ever made of photographs from life of smallpox patients. They show the vagaries and variabilities of the disease not only in mild epidemics as mentioned above, but also in the most virulent outbreaks occurring since his time.

In the progress from nature to photograph to halftone to reproduction in this book, something has been lost; on the other hand, prolonged and detailed study of the lesions and their distribution is sometimes more convenient with the plates than in the living. The text is primary; reading the plates and their legends is secondary.

As mentioned in the preface, Dr. Byles' photographs were not taken during an epidemic and therefore are somewhat deficient in respect to the unusual hemorrhagic or toxic cases. Such

cases, almost uniformly fatal, have repeatedly been missed, thereby initiating serious spread of infection. This was true in the 1962 English outbreak of 62 cases, 39 percent fatal. Also, some of the statements and figures in the last chapter regarding vaccination need slight changes in the light of subsequent experience: for assurance of protection, the height of the vaccination reaction should be reached before exposure. Similarly, the limits of the incubation period should be stretched in both directions, beyond the limits given on page 61, to about 1 week and 3 weeks for rare cases of severe and mild infections respectively. Clemens von Pirquet's careful observations (*Vakzination,* 1908) on the skin reactions following vaccination and revaccination supersede the statements on page 143. Some of the diction and phraseology, most logical and correct, may seem strange to the present-day American reader: such as the use of *caul, rupial, squame, navvy,* even of *flank* and *loin, elliptic* (omitting some usual places of distribution), *immobile* (not disappearing on pressure, applied to an erythema or areola). Nonetheless, for anyone taking to heart every sentence of Ricketts' text, including his own cautions as to undue reliance on limited features of his diagnosis by distribution, mistakes in the diagnosis of this tricky and dangerous disease will be almost eliminated.

In this reproduction the plates have been bound separately under Arabic numerals for easier reference in reading the text.

The original book and illustrations were prepared by Dr. Ricketts and Dr. Byles as full-time officers of the Metropolitan Asylums Board and

the costs were defrayed by that Board. The Dartford Hospitals Management Committee of the Ministry of Health are the successors of the Board and through the great courtesy of Dr. C. Frank Cosin the permission of the Committee was given for this reproduction. Dr. Cosin, who is director of the department of the hospital in charge of the original negatives, also kindly furnished prints of the negatives from which most of the plates were made. However, for the present small edition, reproductions were made from the halftones in the book, instead of from the prints.

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Louis Jacobs,
Chief, Division of Foreign Quarantine,
U.S. Public Health Service,
Department of Health, Education, and Welfare.

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BY

T. F. RICKETTS

M.D., B.Sc. (Lond.), M.R.C.P., D.P.H.

Medical Superintendent of the Smallpox Hospitals and of the River Ambulance Service of the Metropolitan Asylums Board

ILLUSTRATED FROM PHOTOGRAPHS BY

J. B. BYLES

M.B., B.C. (Cantab.), F.R.C.S. Eng., D.P.H.

Senior Assistant Medical Officer at the Smallpox Hospitals of the Metropolitan Asylums Board

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PREFACE

It is ten years or more since the author conceived the notion of writing this book. He was deterred by the consideration that it would have but little value unless adequately illustrated, and to the execution of that part of the task he did not see the way. Some years later the project was revived at the suggestion of Mr. E. L. Meinertzhagen, chairman of sub-committee of the metropolitan smallpox-hospitals, who urged the author to undertake the preparation of the work and secured the co-operation of the Metropolitan Asylums Board. It is owing to the facilities extended to us by the Board that the realisation of the project has become possible.

As to the importance of the subject and the need for its exhaustive treatment there will probably not be two opinions, though there may be several opinions about the value of this result. Perhaps the most noteworthy difference from the teaching of previous writers on the subject resides in the importance attributed to the distribution of the eruption: a diagnostic criterion which has been lifted from a subordinate to a leading position. This doctrine may sound more novel elsewhere

than in London, where it has been taught by the author to his colleagues and pupils for the last fifteen years. It has been abundantly justified by the experience gained in the diagnosis of many thousands of cases.

In spite of the number of illustrations, there are still some gaps which remain unfilled or are filled imperfectly. This circumstance is due to the fact that while the work has been in preparation smallpox has not attained epidemic proportions in London, and certain subjects of infrequent occurrence have not been available for record. Thus it would have been an advantage to present some further illustrations of hæmorrhagic or toxic smallpox.

In compensation, we are so fortunate as to have several of the illustrations in colour. These, we think, will be of particular value in conveying accurate and life-like impressions of the subjects treated. It may be of interest to state that, with the exception of the frontispiece, these colour-plates are produced from triple negatives obtained by the Sanger-Shepherd process of colour-photography. We believe this to be the first medical work which has been freely illustrated by means of colour-photographs taken from life. Very obvious is the advantage in point of fidelity over the coloured illustrations of medical subjects ordinarily obtained by means of water-colour drawings.

Among the half-tone plates are a number of stereoscopic subjects. Readers are advised to

examine these through one of the cheap pocket-stereoscopes which may now be obtained at many opticians'. In spite of the fact that the cross-hatching of the process-screen becomes unduly obvious when magnified by the stereoscope, considerable assistance will be derived from its use. But these stereoscopic prints are, of course, by no means valueless when viewed by the naked eye.

With one exception (Plate XXXIII., Fig. 2), all the prints are from photographs taken of patients with smallpox or of patients whose illness had been mistaken for smallpox. For the photographic original of Plate XXXIII., Fig. 2, we are indebted to Dr. A. F. Cameron, of the South-Eastern Metropolitan Fever Hospital.

We take this opportunity of expressing our great indebtedness to Dr. Frederick Thomson, medical superintendent of the North-Eastern Metropolitan Fever Hospital, and at one time acting medical officer of the Metropolitan River-Ambulance Service for smallpox. To his co-operation we owe opportunities of securing records of several of the cases of mistaken diagnosis illustrated in the plates and of some cases of smallpox which, without his assistance, would have come under our notice too late to be of value.

T. F. R.
J. B. B.

October, 1908.

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THE DIAGNOSIS OF SMALLPOX

CHAPTER I

INTRODUCTORY

THE times have changed since the days of Jenner. Besides that we have less practice in the art, several circumstances cause the diagnosis of smallpox to present to us more difficulties than to our forefathers. To Jenner we owe the chief of these difficulties. Through him, smallpox has become a different disease, easier to suffer but harder to distinguish; and the simple rules which were once enough are now sometimes apt to fail us.

Two-thirds of the errors in the diagnosis of smallpox arise from its confusion with chickenpox. Only a little before Jenner's time did chickenpox come to be distinguished clearly from the graver disease. Indeed, it was not until well into the nineteenth century that the identity of the two disorders ceased finally to be a matter of serious controversy. Even at the latter end of the century Hebra appeared, like a modern Nestor, maintaining still the ancient heresy. That the two diseases are clinically distinct, that they are distinct pathologically, that one protects in no degree against the other, that there is no such thing as a hybrid between the two, these now are fundamental axioms. When the two things were accepted as the same and no necessity arose for their distinction, half the difficulties of diagnosis had not begun to exist.

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The importance of the problem, too, has immensely increased. Once it was everybody's lot to get smallpox, and there was little attempt to segregate the afflicted. A wrong opinion was then of no great consequence, and an extreme precision of diagnosis was hardly worth the trouble of attaining. A correct opinion and an early opinion are now of the first importance, however insignificant may be the attack, and for such an opinion to be formed a close scrutiny of the signs and symptoms is frequently essential. But before proceeding to the analysis it will be desirable to make a preliminary study of the ground to be surveyed.

Of rashes, toxæmic and focal.—Everyone recognises that there is a pathological distinction to be drawn between such a rash as may be caused by eating shell-fish and the skin-lesions of scabies or of lupus. The one is provoked by the circulation in the blood of a chemical poison, the others by the local action of certain parasites in the skin.

A similar distinction is suggested by the infectious exanthems whose eruptions fall, some into one class, some into the other. The vesicles of chickenpox, perhaps also the rose-spots of enteric fever, are caused by the local action of certain micro-organisms. The rashes produced by the injection of the antitoxin of diphtheria, the rash of hæmorrhagic diphtheria, and doubtless the rash of scarlet fever also, are all caused by the circulation in the blood of peculiar chemical products.

There are some differences in the clinical symptoms which commonly accompany the two kinds of rashes. What may be called the focal rashes do not necessarily evoke any serious constitutional disturbance. If this occurs, as it sometimes does, either it is in proportion to the extent and severity of the focal rash, or else it is provoked by another cause. On the other hand, the toxæmic rashes are commonly accompanied by fever or by constitutional disturbance which is caused by the same poison whose circulation in the blood produces the rash itself. The toxæmic rash is but one symptom of the intoxication.

A further distinction lies in the fact that toxæmic rashes are generally diffuse, while focal rashes are commonly composed of circumscribed lesions; or the latter, if diffuse, are unsymmetrical, as with erysipelas. But the point must not be pressed, since circumscribed lesions are met with in some drug-rashes, and also in those toxæmic rashes which are made up of small hæmorrhagic extravasations.

The exanthems, then, are signalised in some instances by a focal rash, in others by a toxæmic. Smallpox, therefore, is exceptional; for it is a disease which presents examples of both kinds of rash and exhibits the symptoms characteristic of each.

The variolous rashes and febrile states.—When a person falls ill with smallpox the first symptoms are those of a general intoxication. There is a sudden rise of temperature and the common symptoms of a febrile toxæmia. The duration of the toxæmia is about a week, and during its course the patient may develop a toxæmic rash of one kind or another. The toxæmia may even be fatal; in that case the patient is said to die of hæmorrhagic smallpox. This variolous toxæmia is precisely analogous to that of scarlet fever, and the rashes which are sometimes evoked by the former are analogous to the rash which is characteristic of the latter disease.

If this were all, smallpox would be a disease simple to understand, if often difficult to distinguish. Its peculiarity is that, half-way through the primary toxæmia, a focal rash is developed, which may be insignificant, but is sometimes so severe as to be capable itself of causing serious illness or even death. The focal rash, like most focal rashes, consists of circumscribed lesions; and the constitutional effects which they produce are in direct proportion to their number and severity. A boil is a focal lesion inconsiderable in effect; but if the body were covered with boils the illness to which they would give rise would be serious and the fever considerable. It is so with the focal rash and secondary fever of smallpox. A chart is reproduced

which shows the distinction between the two fevers whose combination makes the complete disease.

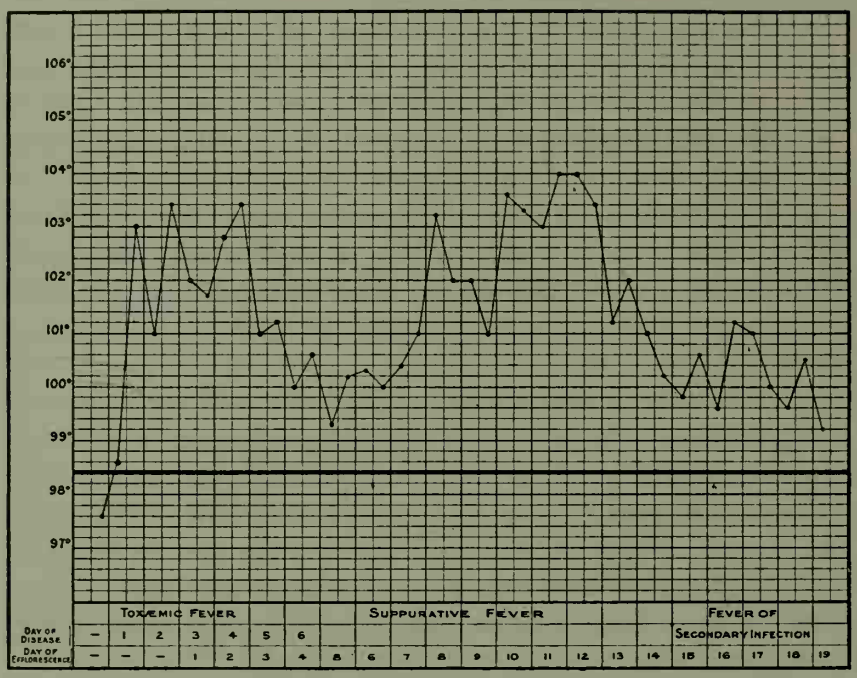

Chart I.—Confluent Smallpox with Severe Suppurative Fever.

The secondary fever is a mere fever of suppuration. The focal rash, which causes it, makes its appearance on the third or fourth day of illness. The rash consists of a number of skin-lesions scattered over the surface of the body, each of which is the seat of inflammation so intense as to lead in the course of four or five days to the formation of a small abscess. Within a few days more the contents dry up or are partly emptied by rupture. A crust forms which becomes detached when the lesion has healed and leaves a small scar if the injury was deep enough. The number of lesions which are present may not amount to a dozen; or there may be many thousands of them, and they may be set so closely as to conceal almost the whole cutaneous surface.

The diagnosis of smallpox turns in most cases upon

the character of the focal rash. The evidence presented by the rash depends partly upon the anatomical character of the individual lesions, partly upon their disposition in relation to the surface of the body, that is to say, upon their distribution. It has been the accepted teaching to give precedence to the former body of evidence. That practice, intelligible in years gone by when modified smallpox was the exception, is now less easy to justify when modified smallpox is the rule. The evidence from position, there can be little doubt, is in most cases more intrinsically valuable than the evidence from character; it is certainly the more easily observed and the more generally dependable. In the chapters which follow, therefore, the salient feature of the disease, the focal rash, will be described first to the exclusion of the symptoms of the toxæmia; and the distribution of the rash will be dealt with at some length before an attempt is made to indicate the peculiarities of the lesions of which the rash is composed.

CHAPTER II

DISTRIBUTION

ALL rules have exceptions, although if we but knew it there should be a reason for every irregularity. The rules of distribution may be derived from an examination of the rash in a number of cases of smallpox; but in certain cases there will be observed some very remarkable deviations from the common pattern. The irregularities to which allusion is made present themselves as streaks or clusters of closely-set pustules, for the existence of which, however, there is generally a good and obvious reason. They may be called irritation-patches. Many writers on the subject have referred to them. But to regard them as pathological curiosities, merely, would be a cardinal error, for by the light of these exceptional instances all the common laws of distribution may be explained.

Some striking examples in point are depicted in Plates I. and II. In one case the impression of a mustard-leaf came out in relief. In another a crop of pustules matured after an injury to the cheek. A not infrequent exciting cause of such a cluster is a successful vaccinal inoculation done during the period of incubation. (Plate I., Fig. 2.) The patches are evoked by antecedent irritation, mechanical, chemical, or inflammatory. They may be of any size; a patch may cover a square foot of surface or an area no bigger than a finger-nail, the less conspicuous instances being relatively common. (Plates X., Fig. 2, XIX., XL., and LV., Fig. 2.)

The influence of attire.—Even more interest attaches to the curiosities of distribution caused by the friction or intermittent pressure of articles of clothing. One such instance is forcibly illustrated in Plate II. (Fig. 2), which

exhibits the lines of friction of the tape and towel on the abdomen of a woman. In another case (Plate III.) an eruption of unwonted density was generated by irritation from a vest. In the latter case the patient had been upon tramp, and the effect was enhanced by a sweaty skin. Doubtless the influence of sweat is an added factor in many of these cases, since they are observed more often in summer than in winter. Other well-marked examples figure in the illustrations. (Plate IV.)

Those are the grosser effects. Minor instances of the influence of attire are more frequently encountered. The pressure of a collar-stud, friction from a collar, the chafing of the underclothing on the axillary folds, the pressure of the corsets against the sternum, the pressure of a brace-button, the rubbing of the stocking or garter against the hamstrings, the chafing by the boot of the tendo Achillis or of the tendons along the front of the ankle-joint; some such incidents mark their effect in the majority of cases of smallpox, and many secure a record in some of these plates. (Plates V., Fig. 1, VIII., Fig. 1, IX., Fig. 2, X., Fig. 1, XIV., XVI., Fig. 2, and XXV.)

Pathology.—Irritation-patches are liable to occur on any part of the body. They are not determined by heat or cold, by drought or moisture. They are independent of exposure to air and of protection by clothing. They occur among the washed and among the unwashed, and on clean parts of the skin as well as on dirty. How do they happen? The factor common to all cases is a disturbance in the balance of the cutaneous circulation. And from the fact that the blood-vessels are involved essentially, it may be inferred that the infective particles are blood-borne, and that the focal lesions are produced by the precipitation of the particles out of the blood-stream into the skin. Smallpox, that is to say, in its pre-eruptive stage, is a septicæmia.*

This conclusion is in harmony with what can be deduced

* The alternative hypothesis would be that the increased activity of the cutaneous circulation manures a soil already containing the dormant seeds of disease, most of which would otherwise fail to germinate and fructify. Stripped

as to the most favourable time for the effective application of the irritant. In many instances it has operated in the course of or before the period of incubation; but in such cases the vascular consequences have persisted, or have been such as might have persisted, until the onset of illness. And in other cases the application of the irritant and the onset of illness have been actually coincident; or it may be, even, that the former has not long preceded the outcrop of the rash.

Less obvious is the exact mechanism by which the precipitation is effected. An adequate explanation of an irritation-patch may be, merely, that a greater volume of blood passes through the capillaries of the area affected and, therefore, that the number of infective particles circulating in that area is proportionately increased. But mere exuberance of blood-supply is probably not the only determining factor, because inflammation of the skin does not necessarily have this peculiar effect; moreover, the relative excess of eruption is often out of all proportion to the excess in blood-supply. (Plates II., Fig. 1, and III.) An ancillary, if not the essential cause, should probably be sought in some of the concomitant vascular changes; in an alteration of the calibre of the vessels, in a change in the velocity of the blood-stream, or even, it may be, in a morbid

of metaphor and stated in pathological terms, this thesis sounds less attractive. Moreover, it is difficult to reconcile with the facts set forth in the rest of this chapter, and it does not harmonise with any tenable theory of the pathology of the disease.

The apparent difficulty of reconciling the ordinary phenomena of the disease with the assumption of a general infection by a single micro-organism has led to the enunciation of various hypotheses. Thus Birdwood (*Guy's Hospital Reports*, Vol. XLVIII., 1892) assumed smallpox to be purely a skin-disease, the infection single and engrafted from without. Perhaps the favourite hypothesis has been that which assumes a general specific infection predisposing to and allowing of a secondary infection by ordinary pyogenic organisms, to which the cutaneous lesions are due wholly or in part. Félix, however (*Bulletin de la Soc. Vaudoise des Sc. Nat.*, Vol. XXXIX., 1903), suggested a double simultaneous infection through the mucous membranes by a specific micro-organism and by unspecific streptococci; and Washbourne (*Guy's Hospital Gazette*, Vol. XV., 1901) suggested a similar conjoint infection by two unknown confederated organisms, both specific.

alteration of the endothelial wall. The mechanism of precipitation must be something in the nature of an embolism. It is not necessary to suppose that the embolic particle actually blocks the vessel; more probably, it becomes attached to the wall of the capillary loop in a papilla.* And what would best conduce to that event would be not so much a greater flow of blood, which would merely cause a greater number of infective particles to pass through the loop in a given time, as an actual slowing of the current, which would assist in their precipitation.

Such a slowing of the blood-current occurs during inflammation, though not in all stages of it nor, necessarily, in all parts of the inflamed surface. While an increased velocity would, in itself, cause a greater difficulty in the deposition of the infective particles, too great a slowing or an actual stoppage of the current, by stopping the circulation of the infective material, would tend, unless the particles were present in inordinate numbers, to precisely the same result. In fact, evidence is sometimes presented that blood-stasis is unfavourable to the development of the rash. A strong stimulus—for example, that of a mustard-leaf—may cause an actual blood-stasis and determine an absence of the rash over the area of application. The point receives illustration in Plate V., Fig. 2. (*See also* Chapter X., p. 69.)

Cutaneous stimulation.—In many of the instances where an aggregation of pustules can be observed, the skin has been irritated but not inflamed. In many cases the irritation was so slight that the patient was unconscious of it, though the position of the patch on some part of the surface which is commonly exposed to friction demonstrates the cause of its origin. To the production of a temporary or of a periodical slowing of the capillary blood-current, actual inflammation, indeed, is by no means necessary. Mere stimulation of the skin causes first contraction, then expansion, and lastly

* It does not follow that such a particle must have an excessive minuteness. By agglutination into a clump, and by an aggregation of leucocytes around such a clump, a mass might be formed sufficient even for the occlusion of a vessel.

re-contraction of the arterioles. And a stimulus, constantly repeated, will cause the blood-vessels so to oscillate that there will be an alternation of an increased and a diminished velocity. Doubtless in most of these cases such a periodical slowing of the current is the determining factor.

The converse holds good. During the earliest stage of the illness, if a part of the skin be artificially protected from stimulation, that part will become liable to the eruption in less degree than the corresponding area on the other side of the body. Convincing illustrations of this fact are not of frequent occurrence. They may be encountered, sometimes, when the patient has fallen ill of smallpox while under surgical treatment for another malady. Under such circumstances a sparse eruption is apt to be developed on the part covered by the dressing; but the dressing must not have been irritative, nor must the part have been inflamed. Again, when a patient comes under treatment before the outcrop is complete, it is sometimes possible to produce the same effect by design; but under such circumstances, as might be expected, a conspicuous contrast is not easy to obtain. Plate VI. represents the issue of such an attempt. A case seized at the very onset of the illness would doubtless display a more striking result.

Now let the assumption be made, that to influence the disposition of the eruption does not require an extraordinary stimulus or a state of inflammation, but that the trivial kinds of stimulation to which the skin is ordinarily subject may upset the balance of the capillary circulation sufficiently to enhance, however slightly, the susceptibility of the overlying skin. Let it be assumed, further, that if the skin be screened, even imperfectly, from stimulation, a contrary effect will be produced. It should then follow that evidence of the operation of these laws should be forthcoming, not merely by a freak of fortune in the exceptional case, but also in the case of common sort which may come under notice to-morrow. And that is just what happens. Broadly speaking, the hollows and shallows of the surface tend to escape the rash at the expense of the ridges

and prominences. Conspicuous illustrations of the statement are furnished in Plate VII. In those instances, the prominence merely of a tendon was sufficient to attract along its contour a few out of the scanty stock of pustules with which the patient was endowed. The connection between cause and effect is not always so clear, but a little research will generally reveal it. On account of the well-marked prominences and depressions which it displays, perhaps the facts can most readily be demonstrated on the foot.

Distribution on the foot and hand.—Relatively to the rest of the body, the foot is very inconstant in its susceptibility to the eruption. This is doubtless due in part to differences in the comfort of the boot; but a disturbing factor even more cogent is the variety in the habits of the patient. One who walks much will get on the foot a relatively thicker rash than the patient of a sedentary life. And he will come worse off than either who, unused to much walking, takes to the road just before he falls ill. Such factors influence not only the amount of the eruption, but also its disposition. In most cases, the back of the foot suffers more than the sole (Plates IV., Fig. 2, and VIII.); but overmuch standing or walking is apt to evoke an eruption of extraordinary profuseness on the soles, round the margins of the soles, and over the toes. (Plate IX.)

Whatever the relative density may be on the back of the foot and on the sole, very few spots are developed between the toes, or in the folds beneath the toes; for these are sheltered places. Similarly, the shallow over the heads of the metatarsal bones tends to escape, and the hollows behind the malleoli, and the arch beneath the foot. (Plate VIII. and Plate IV., Fig. 2.) A dirty foot is a good teacher: where the dirt sticks, from those places is the rash averse; where the dirt gets rubbed away, there the rash comes thicker. The instep, especially the tendinous ridges and the bony eminences, the tendo Achillis (Plate X., Fig. 1), the backs of the toes, the heel, the balls of the toes, and the toe-pads (Plate IX.), some or all of these the rash takes for its chosen habitations.

Standing out as pronounced exceptions to the rule, the malleoli, in many instances, enjoy a comparative immunity. (Plates VIII., Fig. 2, and IX., Fig. 2.) When low shoes are worn, the malleoli are subject to the common law. (Plate IX., Fig. 1.) The exceptional instances occur among those who wear a well-fitting boot. In a foot so encased, the malleoli suffer but little friction with the leather, since they are situated at the fulcrum of the lever; and since they are protected by the leather from extraneous friction, they are correspondingly protected from the rash. Some other differences may generally be noticed, according as the patient has worn boots or shoes. Round and above the ankle, in the latter case, the disposition of the rash is influenced by such agencies as the friction of the sock, of the trouser-ends, of the skirts; and though the incidence of the rash may be less or greater, according to the circumstances of the case, its disposition differs in kind from that which would be produced by the boot itself.

In spite of a general similarity, hardly two feet are alike in the precise manner in which the eruption is disposed. Account must be taken of differences, not only in the habits of the patient and in the foot-gear, but also in the conformation of the foot. The concavity of the sole will suffer relatively less among those with high-arched feet (Plates IV., Fig. 2, and IX., Fig. 1) than among the flat-footed. (Plate X., Fig. 1.) The backs of the toes, as well as their extensor tendons in their course over the bases of the proximal phalanges, will be more subject to friction among the claw-toed and will earn a thicker rash. (Plate IX., Fig. 2.) The malleoli, again, and the tendinous ridges of the foot vary in prominence in different persons, and produce a correspondingly variable effect. In general, a plump foot shows in the disposition of the eruption less conspicuous contrasts than a thin one.

Because of the more even contour, the contrasts displayed by the hand and forearm are much less pronounced. (Plates X., Fig. 2, and XLVI.) They may be distinct enough when the hand has prominent bony and tendinous

ridges, but if it is smooth and plump the distribution may be singularly even. The extensor surface suffers most, and the palm of the hand is generally comparatively immune. (Plates XI., Fig. 1, and XVII., Fig. 1.) The rash tends to be most pronounced on the back of the wrist and hand and over the heads of the metacarpals, since those parts are the most exposed. In many cases the rash is accented along the radial or ulnar edge of the forearm, or along both; and at the flexure of the wrist it is sometimes exaggerated on account of the rubbing of the sleeve. The incidence is distinctly less between the fingers than along their backs, and in the hollow of the palm than on the muscular eminences which bound it. The precise disposition in a particular case depends a good deal upon the patient's occupation. (Plate XI., Fig. 2.)

CHAPTER III

DISTRIBUTION (continued)

Scheme of distribution.—Given that the pattern of the eruption on the foot is moulded almost wholly by circumstances, is it probable that the general scheme of distribution on the rest of the body is governed by an arbitrary and conventional rule? The facts are not so; the greater includes the less, and the laws which are effective for the part are valid for the whole. The operative causes are manifold; but the most potent factors are exposure to air and friction with clothing, and to their efficacy every case of smallpox is a testimonial.

The brunt of the attack falls upon the face and hands. (Plate XII.) These are just those parts of the skin where disfigurement can be worst endured, since they are kept habitually uncovered. And it is because they are unclad that they suffer exceptionally; for they are exposed thereby to unceasing stimulation from wind and weather, from changes of temperature, and from manipulation. The face is exposed the more constantly, and it exceeds the hand also in its blood-supply; more infective particles pass through the vessels of a given area, and they have a greater chance of precipitation. For these reasons the incidence on the face is greater than on any other part of the body.

On the covered parts distribution is most influenced by friction with the clothing, and friction is determined by movement. Of the three members—the upper limb, the lower limb, the trunk—the first is the most mobile and the most moved, and it sustains the thickest rash. (Plates XIII., Fig. 2, and XIX.) In mere amplitude of movement the lower limb surpasses the trunk; but the trunk, as a rule, is in more constant though in more restricted motion. Hence the leg, in most cases, is less susceptible than the trunk.

A striking characteristic of the disease is that the back and front of the trunk are very differently affected. The bulk of the rash is found behind. In front it is more sparse than on any other large part of the surface. (Plates XVIII. and XIX.) This peculiarity of distribution is very easy to understand by considering the shape and habit of the body. The flexure of the spine looks forward. Nearly every movement, especially with the more laborious forms of toil, involves the dorsal arch in friction with the underclothing. The shoulders, indeed, sustain an amount of friction but little less than that suffered by the arm, and it is over the shoulders that the rash comes thickest. (Plates XIII. and XIV.) The pivot on which the trunk moves is the pelvis. In the movements of the trunk, the nearer to the pivot the less is the amplitude of motion. The eruption, therefore, grows less from the shoulders downwards, the difference being sometimes pronounced and generally distinct. The rash is least across the loins, and, as might be supposed, its incidence again increases over the buttocks. In front there is a similar gradation, but it is more constant and conspicuous. In a case of confluent smallpox, even, the rash may become excessively attenuated on the lower part of the abdomen. (Plates XV., XVI., Fig. 1, and XXII., Fig. 2.)

On the limbs there is a lineal gradation of density similar to that which occurs upon the trunk. The limbs have most mobility at their distal ends, and the rash increases in density from above downwards. (Plates XII., XV., and XXIV.) This centrifugal distribution is, in most cases, particularly well displayed upon the arms.

A characteristic tendency of the rash is to shun the most sheltered parts of the cutaneous surface. These are the great flexures of the body. The armpit, perhaps, of all parts is the most efficiently screened, and consistently enjoys an immunity which is virtually complete. (Plates XVIII. and XXII., Fig. 2.) An immunity hardly less ample is shared by the groins and the hypogastrium. (Plate XVI., Fig. 1.) The flexures of the limbs are very imperfectly protected, but in the bend of the elbow and in the popliteal space it is the

rule for the rash to be noticeably less dense than on contiguous parts of the skin. (Plates XVI., Fig. 2, and XVII., Fig. 1.)

Just as the flexures are relatively secure against the rash, the counter-parts on the extensor surfaces earn a disproportionate share. The elbow is peculiarly apt to display a thick crop. (Plate XVII., Fig. 2.) Similarly the rash is denser over the deltoid and on the outer surface of the arm than on the inner side which comes against the chest wall (Plates XVIII. and XIX.); it is thicker on the extensor surface of the fore-arm than on the flexor; thicker on the back of the hand than on the palm. On the leg and thigh, which, being less active than the arm, sustain a more scanty rash, the disposition of the rash, for precisely that reason, presents less conspicuous contrasts; but the contrasts exist and are in the same direction. (Plate XX.)

The broad features of distribution are, therefore, that the rash prefers the upper half of the body to the lower, that it is a rash of the face and arms rather than of the trunk and legs, that it is a rash of the distal ends of the limbs rather than of the proximal, of the back of the trunk rather than of the front, of extensor surfaces rather than of flexor, and that it is a rash which shuns the most pronounced flexures.

The disposition in detail.—In the last chapter a description was given of the detailed disposition of the rash on the foot and hand. Those finer shades of contrast, though they may be deemed of little moment, become of the first importance in appropriate cases, and it is necessary to take a careful account of them. But it is not on the limbs so much as on other parts of the body that they assume their greatest practical value.

On the face, though there is a superficial uniformity of distribution, a closer examination reveals the choice of the rash for the more exposed and prominent parts in contrast to the more sheltered. (Plates XXI. and XXII., Fig. 1.) Its aggregation about the forehead, nose, and malar prominences causes it to be apportioned unequally from above downwards. A line drawn from the meatus of the ear to the ala of the nose divides the face into two parts, on the lower of

which the rash is noticeably less dense. The region most screened from irritation is the orbit, and there the rash is relatively sparse. Even the depression of the temple commonly wards off a fraction of its proper share. Under the chin the rash is more scanty than above (Plate XXV.), but the extent to which the submaxillary region suffers depends upon the amount of fat under the chin, upon the conformation of the jaw, and upon the habits of the patient. Little children and people with a double chin may develop an abundant eruption below the jaw.

The ear commonly displays the rash, the exposed surface more than the back of the shell. The lesions are set along the edge of the shell and along the convexities of its folds rather than in the grooves between them. (Plate XXII., Fig. 1.) The prominence of the mastoid does not generally escape, but the skin in the angle behind the ear is sheltered by the ear itself, less or more successfully according as the shell is prominent or retracted. More conspicuous is the relative immunity of the groove beneath the lobule.

The neck, lying sheltered between the protuberance of the head above and of the shoulders below, is less subject to the rash than either. In some cases the neck is encircled by a distinct line, above and below which there is a pronounced contrast in density. (Plates XLVIII. and LIV., Fig. 1.) Such a line marks off the part covered by clothing from that exposed to the air. In most cases this contrast is wanting or inconspicuous.

The back of the neck suffers most. (Plate XXII., Fig. 1.) In front, the muscular and tendinous and bony ridges at the root of the neck present in appropriate cases peculiarly valuable opportunities of contrast. (Plates XXIII. and XXV.) Even when the rash is relatively scanty, it is readily seen to pick out the sterno-mastoid and its prominent tendons, and the edge of the trapezius, and to avoid the suprasternal, supraclavicular, and even the infraclavicular hollows. Along the ridge of the clavicle, curiously, the rash is often less pronounced than might be expected.

It will be noticed that the flank, lying sheltered beneath

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the arm, suffers less from the rash than those parts of the chest-wall which adjoin it in front and behind. (Plate XXII., Fig. 2.) When the patient is well-built, the rash is distributed differently over the prominent scapular regions and in the interscapular groove (Plate XIII.), over the swelling pectorals and in the sternal hollow. (Plate XXII., Fig. 2.) Exceptionally the lines of the ribs even are mapped out. (Plate XIV.)

Anomalies of distribution.—If habit of life and conformation of body are the chief determining factors, why is not variety in distribution commensurate with the variety of form and habit among the people? A considerable divergence from the normal is seen occasionally when the whole mode of life is unusual, for example in the case of a bed-ridden paralytic or of a young infant. Yet the difficulty is rather to explain the variations which occur in common cases than to account for the prevailing uniformity. For whatever the habit of the individual, the relative activity of different parts of the body is much the same in all. Clerk and navvy, alike, keep the face uncovered, the arms more active than the trunk, the back more exposed to friction than the chest and abdomen. It must be remembered, too, that for the skin to be irritated requires that it shall not have become inured to the irritant. Manual labour is less hurtful to the workman's palm than to the hand of the clerk. The ever-varying frictions and irritations falling hourly on the skin count more than the habitual frictions to which it is inured. And again, when the onset has been sudden and the illness severe enough to interrupt his mode of life, it is of paramount importance, not so much what the patient was doing when full of vigour yesterday, as what he does to-day when his vessels contain the infective particles.

The trunk, of all parts, displays the most variety in its liability. The relative density of the rash on the back, chest, abdomen, is almost invariably maintained; but instead of coming next to the arms in its aptitude for the rash, the back bears, in some cases, a crop which is relatively inconspicuous. Women and children are most apt to show

this peculiarity. (Plates XIII., Fig. 2, and XXIV.) The probable cause of it is that men lead a more active life, while women keep the movements of the trunk restrained and its surface protected by the use of corsets. In the case of a fat, sweaty woman, or with a patient whose corsets do not fit, the corsets may have an opposite effect and induce the development of a rash out of proportion in its density. (Plate XXV.) The use of corsets, and their fit, influence also the incidence of the rash on the abdomen, but in this instance what counts more is the shape. Patients with thin retracted abdominal walls are less likely to suffer than the fat-bellied.

There is less, but still considerable, variety in the relative incidence on the leg. This, again, is an effect of activity and dress by which women come off the best. Children are ape-like in the relative activity of the lower limbs, and there is often little to choose between the density on their legs and on their arms. (Plates XV. and XXIV.)

Striking variations occur in the gradations of density along the length of the limbs. The rule is for the density to increase from above downwards. From such differences as there may be in the habits of a workman, of a woman of inactive life, or of a child-in-arms, the contrasts of the normal centrifugal disposition may be either exaggerated or repressed. What is more surprising is that sometimes there is an actual reversal, so that the density, as with chickenpox, increases from below upwards. (Plate XXVI.) Such a reversal is the more important when it is found on the arms. It is most apt to occur in cases of modified smallpox. It is not very infrequent, and usually a reference to the habits of the patient does not explain it, so that it may be a real disturbing factor in diagnosis.

Under such circumstances, the rash may never reach the hand; but there are other cases in which, while the arm and forearm exhibit the normal gradation, the hand alone enjoys a relative immunity. (Plates XVIII. and XIX.) In rare cases there is a reversal of the order of incidence on the extensor and flexor surfaces of the arm.

Partly that our knowledge of causes is imperfect, and partly because we cannot hope to elicit all the pertinent facts in every case, it is too much to expect an explanation of all such vagaries. Yet the exceptional cases are fewer and less misleading than they would be if we considered distribution to be governed by an unknown law or by an empirical rule. And if a discrepancy occurs in the evidence derived from a part of the eruption, it will be corrected by the accumulated testimony of the whole.

The finer details of distribution exhibit similar differences, and similar considerations apply. A particular prominence or depression will not be similarly affected in all cases. Very much will depend upon the conformation of parts in each particular case. Because a few spots are seen in the armpit, because the orbit is filled, or because the rash is undeveloped on a tendinous or bony ridge, that is no bar to a diagnosis of smallpox. What is to the point is that, taken as a whole, the protected areas are deficient in eruption relatively, and the more so in proportion to the degree of protection.

The scalp and air-passages.—Patients differ widely in the susceptibility of the scalp. In some cases it rivals the face, in others it almost wholly escapes. Other causes contribute to this difference, but the most telling is the effectiveness of the hairy covering. Bald-headed people come off the worst.

The mucous membranes of the air-passages are subject to the eruption, the visible parts most liable to it being the hard palate, the tip and edges of the tongue, and the pillars of the fauces. Different patients show remarkable differences in the susceptibility of these structures. In cases of equal severity, the lesions may be few or absent, or the mouth and throat may be covered by a confluent rash which may extend into the larynx and trachea. Notoriously the mucous membranes of different individuals exhibit great differences in the stability of the vascular equilibrium. And just as they differ in their susceptibility to catarrh, so do they differ in their vulnerability to the rash.

CHAPTER IV

DIAGNOSIS BY DISTRIBUTION

THE eruption of smallpox is co-extensive with the cutaneous circulation. Its lesions may be developed even under the nails. And there is no region which is peculiar in being liable to the lesions of smallpox but immune to those of other diseases. The mere fact that the lesions are present or absent on the soles, or on the palms, or on the mucous membrane of the mouth, is irrelevant to the problem of diagnosis.

Localised or elliptic rashes.—Since it is the essence of this rash to be diffused over the whole cutaneous surface, a pronounced limitation of the area of diffusion is generally very cogent evidence that a rash is not variolous. However like the lesions might be, such a limitation as that represented in Plate XXVII. would put smallpox out of count. Even when the rash occupies a greater space, the distinction may be equally easy; for example, if its incidence were limited to the face and arms, or to the trunk of the body, or to the limbs. (Plate XXVIII.) In other cases the exclusion will be influenced by the fact that the rash, though widespread, is yet elliptic in incidence; as when scabies attacks all parts except the face, or chickenpox all except the arms. In these examples the parts to enjoy immunity are some which it is essential that a variolous rash should cover. Smallpox would not be excluded necessarily if the abdomen, or even the whole trunk, escaped; yet the cases are exceptional in which those parts are wholly unblemished, and their complete immunity would tell something against that diagnosis.

Generalised rashes.—When the eruption is generalised, it becomes more particularly necessary to observe its order of incidence. The vesicles of chickenpox are likely to be strewn more thickly on the trunk of the body than on

the face and limbs, and on the proximal parts of the limbs than on the distal. (Plate XXIX.) An eczematous rash may preponderate on the trunk rather than on the face, on the front of the trunk rather than on the back, on the abdomen rather than on the chest, or on the flexor surfaces of the limbs rather than on the extensor. A large number of cases, which might otherwise prove difficult, may be distinguished by such considerations. (Plates XXX. and XXXI.)

Supposing even that there are none of these faulty contrasts, the evidence would be hardly less cogent should the gradation of density be inconsistent, not in kind but in degree. A confluent rash on the face would be inconsistent with a very scanty rash on the arms, a confluent rash on the face and arms with a relative suppression of the rash on all other parts, or a thick rash on the trunk with a very scanty rash on the legs. Similarly, unless the lesions were developed in insignificant number, their limitation to one surface, even to the extensor surface, of a limb would be almost as inconsistent with smallpox as their limitation to one part of the body.

The gradation, again, must be orderly. With smallpox, an abrupt transition of density may occur at the junction of dissimilar surfaces, for instance, where the thigh meets the groin. (Plates XVI., Fig. 1, and XXIV.) But as a rule, and in the absence of any obvious disturbing cause, abrupt transitions are unusual. Marked asymmetry, uneven gradation over homogeneous areas, or an irrational patchiness of distribution, are all against the diagnosis. (Plates XXXII. and XXVIII.)

Lack of gradation.—The fault may be, not that the gradation is uneven or abrupt, but that it is absent. Cases which cause sometimes a good deal of difficulty are those in which a rash, generalised in distribution, shows no pronounced preference for specific regions. In a case of measles, or of generalised erythema, it may be difficult to say whether the rash is thicker on the face than on the arms, on the arms than on the trunk, on the trunk than on the legs; because it is so equal in distribution or displays differences

so slight. Plate XXXIV. is from a case in which the vesicular eruption resembled closely some that are seen in the severer sorts of smallpox. It was strewn thickly over all parts of the body, and the most obvious difference was a lack on different parts of a distinct gradation of density.

A general lack of contrast rather than a faulty contrast, that is a kind of negative evidence upon which it seems difficult to rely. The tendency is to under-estimate its value. The peculiarity of smallpox is that the differences of density spring from the natural history of the disease; merely the demonstration of their absence, therefore, is evidence of considerable weight. In collecting such evidence it is not enough to take account of the disposition of the rash over large areas and to estimate its relative density on different parts of the body, and on different parts of a limb, and on opposite surfaces of a limb. The armpits and the groins must be carefully explored; the armpit, especially, is a mine of information. (Plates XXIX. and XXXI.) A want of contrast or a reversed contrast in those regions is very weighty evidence against smallpox. And, lastly, there are the many trifling contrasts of disposition described in the last chapter; these must be looked for and their absence noted.

This class of evidence attains its highest value when, in general outline of distribution, the variolous eruption is closely simulated. With exceptional cases of chickenpox the mimicry may be extraordinarily close; yet when the details are scrutinised the similarity disappears. Some of the most difficult cases which fall to be distinguished are cases of measles or of generalised erythema, in which the rash is so closely mimetic merely because it is immature. With smallpox, the rash begins at the top and spreads downwards; on the legs efflorescence is often still incomplete after the lapse of forty-eight hours. (*See* Chap. VI., p. 33, and Plate XLVII.) A similar order of development occurs with measles, and may happen in a case of erythema. The observer, therefore, may be required to classify a papular rash occupying only the upper part of the body,

and for that reason presenting no distinctive features in its salient lines of distribution. And what makes the task harder is that a variolous rash, so immature, may itself display in its order of incidence some apparent anomalies which will disappear as efflorescence advances. In such cases as these, when the common rules of distribution go by the board, its finer details become our mainstay. If the rash comes equally and indifferently in the orbits and on the forehead, on the lower part of the face and on the upper, below and above the chin, on both surfaces of the ear, on the lobule and in the groove beneath it, if it spreads indifferently over the hollows and ridges of the neck and into the armpit, then with some confidence the further development of the case may be awaited. (Plates XXXIII. and XCV.)

Factitious exaltation of density in exotic eruptions.—To exclude smallpox, what is material is to establish the indifference of the rash not only to exposed but also to sheltered places, not only to the prominences but also to the depressions of the surface. It is not pathognomonic that the rash picks out a ridge, or is exaggerated on a part exposed to pressure or irritation. Of such facts, a conspicuous or manifold instance, like some of those depicted in the preceding plates, may clinch the diagnosis which other evidence suggests. But it is important to remember that similar phenomena may be displayed by other diseases. In a case of dermatitis it would not be unusual to find the pustules clustering where the skin had been subject to irritation. In a case of erythema the rash is sometimes accented on a prominence, or in a place exposed to pressure. (Plate XXXV., Fig. 1.) A drug-rash, even, such as that caused by an iodide salt, may furnish an illustration of the same order of fact. And now and then a case of chickenpox will display a garter-mark or the like. (Plate XXXVI., Fig. 1.) Yet, in each instance, in spite of the local idiosyncrasy the rash will preserve a general indifference to the contours of the surface; near the very part, even, which has suffered with peculiar intensity there may be a sheltered nook where the rash, instead of being deficient, is just as pronounced as on most of the neighbouring skin.

Meagre eruptions.—When the rash is scanty these indifferences of distribution are more difficult to establish. The hardest problems arise when the rash is both scanty and widespread, for only the broader features of distribution can then be taken account of, and they may happen to be unconvincing. In such cases, to map out the spots on a chart helps in deciding how lies the balance of evidence. Should the lesions be very few in number, it may be that no valid evidence against smallpox would lie even in a limitation of their area of diffusion; but for such evidence to be invalid they must be so few that they may be counted in a figure approaching a single number. And it will be still true that, if they are variolous, they will be most apt to come on those parts which suffer most when the rash is in plenty. They should be found on the upper part of the body; though there may be no more than a dozen spots, the evidence would be against smallpox if none were found upon the face. (Plates XXXV., Fig. 2, and XXXVI., Fig. 2.)

The faith must never be pinned to one part of the evidence only. There are exceptions to all the rules, and it is not always that the disturbing cause can be detected. A patient may still have smallpox though the rash come on the arm more than on the forearm, or on the flexor surface of a limb more than on the extensor surface, or on the abdomen more than on the chest, or even though the groins be filled. (*See* Chapter X., p. 69.) Yet all the exceptions will not occur in the same case, and if there is no dearth of evidence and all of it is weighed there will be little risk of a faulty judgment.

CHAPTER V

THE LESION

Life-history.—Counting to the time of incrustration, the evolution of the lesion in a case of natural smallpox occupies about eight days. The exact duration of the period depends upon the character of the lesion and upon the nature of the case. Some of the lesions of modified smallpox hurry through their life in three or four days, while in the severest cases of confluent smallpox even the normal period may be prolonged. In the evolution of a typical lesion the time occupied by the several stages is about two days for the papule, two for the vesicle, and four more until the pustule begins to incrust. Relatively to the other, the duration of the papular or of the vesicular stage is inconstant. A day may be taken from the first and added to the second, four days still measuring their combined duration.

At its birth the spot is very small, about as big as a pin's head. (Plates XXXVII., XXXVIII., and XXXIX.) It is just a fleck in the skin, flush with the surface and imperceptible to the touch. In a few hours it swells up into a raised, hard, solid-feeling, pink mass, the papule. In the course of a day or two the small round-topped papule begins to get vacuolated at the top. This change spreads throughout the lesion, which at the same time gets bigger and by the fourth day of its life has become grey and translucent. The smaller vesicles are generally hemispherical, the larger flat-topped, and the crown of the vesicle is sometimes indented. At this stage, if it is pricked or incised, the fluid contents are not wholly emptied; the cavity is loculated. The vesicle remains clear for about twenty-four hours only; its covering then becomes dull and whitish, and, following this change, its contents become turbid. This metamorphosis into the

pustule is a gradual process and, if the lesion be not too small, can be plainly detected to begin at the periphery and to proceed towards the centre. In the intermediate state between the vesicle and the pustule, a white or yellow ring at the periphery of the crown encircles, iris-like, the grey translucent centre, imparting to the lesion a characteristic ringed appearance. (Plate XLIV.) By the sixth day the lesion has turned yellow throughout and contains thin pus; the crown has become dome-shaped and the pustule has arrived at maturity.

Size.—From its birth to its maturity the lesion grows as it ages. The largest papule is no bigger than the head of a bee; the largest vesicle may reach the size of the top of a cedar pencil; and a full-sized pustule is about three-eighths of an inch across. But many of the lesions do not attain these dimensions even in cases of natural smallpox.

The areola.—These statements of size take no account of the areola. (Plates XL., XLI., XLII., and XLIII.) This is seen first during the papular stage. As the papule gains in prominence it becomes encircled by a narrow erythematous zone, which gets broader with the change into the vesicle. The areola is biggest and brightest at the height of the vesicular stage and begins to wane with the onset of suppuration; the pustule, when mature, has no areola. The colour is light red and, under ordinary conditions, is discharged readily by pressure. The breadth of the zone is very variable. It seems to be determined by the intensity of the inflammatory reaction of the skin rather than by the virulence of the destructive process. A broad areola, therefore, is a good sign rather than otherwise. The biggest are seen in some cases of modified smallpox, encircling diminutive vesicles. In such cases the area covered may be as big as a shilling, and the small vesicles so surrounded look very like those met with in some cases of chickenpox.

Involution.—About the ninth day of efflorescence the crust begins to form. In ordinary circumstances the whole lesion undergoes inspissation and, in the course of a few days, a solid brown disc-shaped scab is left embedded in the skin.

(Plate XLV., Fig. 1.) This falls off, in cases of unmodified smallpox, about the fourteenth day of efflorescence. The condition left after the fall of the scab will be referred to in Chapter VIII.

Critical signs.—The characteristics held traditionally to be distinctive of variolous lesions are the loculation of the cavity of the vesicle, its umbilication, and the solidity and hardness of the papule. As reliable guides in diagnosis these signs must be accepted with some qualification. It is obvious that the tests with which they furnish us can be applied only during a certain part of the illness. And, in general, though the demonstration of the signs may be good evidence in favour of smallpox, failure to demonstrate them does not necessarily tell against that diagnosis. Their meaning and the limits of their usefulness will be better understood by reference to the histology of the lesion.

The frontispiece represents a section of a portion of a variolous lesion in which vacuolation was beginning. The lesion occupied the whole depth of the epidermis, had the deeper layers for its floor, and was roofed by the cuticle. At the centre the floor was thin, and by the further growth of the lesion even the deep layer of cylindrical cells would have been worn away and the corium invaded. It is owing to this erosion of the regenerative cells that smallpox leaves scars. Yet, though the corium suffers, it is its upper fringe only, the papillary layer, which is commonly involved in the area of destruction. The inflammation crowds within sharp limits and does not encroach sensibly upon the true skin.

Loculation.—When fluid is effused rapidly into a solid tissue, the tissue splits, and splits along the line of least resistance. With chickenpox the focus of activity is just below the surface, and nothing confines the flow of serum but the overlying sheet of horny epidermis. This the fluid strips up, the natural plane of cleavage lying parallel to the cutaneous surface. But with smallpox the effusion takes place more deeply among the epidermal cells, where there are no natural lines of parting. The columns of cells are forced apart irregularly and the fissures, for the most part,

are perpendicular to the surface. (*See* Frontispiece.) This irregular splitting of the epithelial cells has the effect of dividing the vesicle into many compartments. With the onset of suppuration the walls which separate the compartments break down; the pustule is not loculated.

That the cavity is loculated, is determined by piercing the vesicle and observing that all the fluid contents cannot be emptied through the wound. There are many cases of smallpox in which this test can be applied satisfactorily, and many cases of chickenpox in which, with equal readiness, the vesicles can be shown to be unilocular. Nevertheless, the practical value of the test is inconsiderable; for the cases in which the reaction is unambiguous are those which can be distinguished even more readily by other means. When the vesicles are small or flaccid, as may happen in cases of either disease, it is so difficult to judge of the completeness of the evacuation of the fluid that it is easy to form an unwarranted opinion. Moreover, there are cases in which the reaction to the test would really warrant a wrong conclusion. Vesicles are sometimes loculated in cases of chickenpox, though perhaps imperfectly loculated. On the other hand, unilocular vesicles may be observed not infrequently in cases of smallpox. The circumstances productive of these ambiguities will be discussed presently.

The tactile impression of the papule.—The solidity of the papule is wholly spurious. The effect is produced by the effusion of fluid under pressure. The vesicle of chickenpox is caused by an inflammatory reaction equally acute; but with that disease there is ordinarily no precedent papule because the pressure of the fluid effused is at once relieved by the separation of the cuticle, bound down so lightly to the parts below. With smallpox the focus of inflammation lies deeper; and the expansion of the fluid is restrained by the compactness of the tissue into which it is effused. To separate the cells the fluid must gain a high degree of tension; and some two days go by before it gathers force enough so to tear the tissue that signs of vacuolation are perceptible to the eye. Nevertheless, the vacuoles are there long before they are

evident and the papule derives its firmness from the tension of the fluid which fills them.

When the circumstances are most favourable, the sign is very characteristic. The limits of the papule are remarkably distinct. It projects but little above the surface and feels like a hard, round, foreign body embedded in the epidermis. These qualities, being attributable to the effusion of serum into a compact tissue, are best perceived on the face, where, the blood-supply being most abundant, the effusion is most rapid. Moreover, the frontal bone makes a convenient background for manipulation. The hand and forearm are also situations favourable to the sign. On the soft parts, and in those situations where the skin is soft and flaccid, the peculiar qualities of the papule may be lost even in unexceptional cases; and there are exceptional circumstances in which they may be wholly lacking even upon the face.

Aberrant cases.—There are two essential factors which contribute to those distinctive characteristics of the papule and the vesicle which have just been described. One is the acuteness of the inflammatory process, the other is the position of the lesion among the deeper strata of the epithelial cells. In cases of different kinds, one or other of these factors may be wanting. From any cause which subdues the intensity of the inflammation, or in any case in which the lesions are abnormally superficial, the papules may be soft, and the vesicles may be either imperfectly loculated or so deficient in serous contents that the loculation is imperfectly perceived. For the first reason these tests may fail, especially if the skin is thin and flabby, when the subjects are of feeble vitality and of weak circulation, as in the cases of the very young or the very old. For the same reason they may fail in certain of the more serious forms of smallpox in which the circulation is apt to be defective, as will be related in the next chapter. And for the second reason the tests may fail in cases of highly modified smallpox which are liable to be signalised by particularly small and superficial lesions. It must be remembered, also, that whatever the severity of the attack and however resistant the papule may be destined to

become in its maturity, yet at the time of its outcrop, before the requisite tension has been attained in the fluid effused, it may be altogether wanting in firmness.

Position.—Since these signs depend upon the precise depth of situation of the lesion, it is obvious that if that situation can be gauged its determination will furnish us with yet another test. The skin of the trunk and limbs is easier to manipulate than the thick skin of the face. The tissue should be nipped up and rolled lightly between the finger and thumb. The lesion should be well defined; and it is generally possible to estimate whether it bulks too largely in the deeper layers of the skin, like an acne-spot, or is a mere excrescence on the surface like a chickenpox-vesicle, or really lies embedded in the epidermis.

Often the evidence appeals to the eye even better than to the touch. The lesion of smallpox juts through the skin and lifts the horny epidermis at an angle. (Plate XLIV.) Lesions like acne-pustules or deep-seated syphilides, rooted in the deeper part of the corium, have a greater thickness of skin to push before them and bulge up from below with a more gradual slope. (Plate CXVIII.) On the other hand, superficial vesicles, such as those of chickenpox, appear to lie on the surface of the skin rather than within it. Though the vesicle of smallpox has a steep gradient of slope, it joins the flat skin-surface with a rounded angle. But the vesicles of chickenpox, when the wall is thin enough, spring abruptly from the surface like bubbles on soapy water.

If the lesion is found to inhabit the middle part of the skin, that fact does not necessarily exclude an exotic origin. A syphilitic pustule may have a situation and a character indistinguishable from those of a variolous pustule. Yet, if most of the pustules were found to be so situated, another cause than smallpox would be improbable unless the eruption were sparse. The same sort of remark is true of papular lesions, not because it is uncommon for the papular lesions of other diseases to be situated in the middle region, but because they are seldom so well defined that their depth of situation can be gauged. On the other hand, smallpox is

not necessarily to be excluded because the lesion is superficial or because it is too soft for profitable manipulation. There are exceptional cases in which the same circumstances must be allowed for as were seen to operate in tempering the hardness of the papule.

The two tests, that furnished by the tactile impression of the papule and that afforded by estimating the position of the lesion, are supplementary the one to the other and are the most useful guides in determining the nature of individual variolous lesions. Yet this test has the advantage over the other, that it is capable of wider application. It can be applied in all stages of evolution of the lesion and can be used in many cases in which the papule, though of ambiguous consistence, is still sufficiently distinct for its position to be ascertained.

Umbilication.—By the term "umbilication" is understood a saucer-shaped depression in a distended vesicle, or a mere indentation of its surface, or even a pin-point dimpling. (Plates XLVI., XXXVIII., Fig. 2, and XL.) True umbilication is peculiar to the vesicle. Pustules which have a flattened or a concave surface are encountered not infrequently in cases of smallpox as well as with other diseases. (Plate XLV., Fig. 2.) This effect is caused by the absorption of the fluid contents of the pustule, and by the consequent sagging of its crown. Vesicles, even, if they are flaccid may display a spurious umbilication of precisely similar character and causation.

A spurious umbilication of the vesicles is seen, not infrequently, in cases of chickenpox. But with that disease a real dimpling of the vesicle is sometimes met with. Such a dimpling is caused, generally, by the crown of the vesicle being tethered by the unruptured neck of a hair-follicle or a sweat-gland. Seldom more than a few vesicles are so affected, but in rare cases the phenomenon is more conspicuous.

Whatever the fundamental cause may be, the vesicular indentation of smallpox, like the other signs which have been discussed, depends upon the position of the lesion in the skin. Inconstant always, it is absent in the majority of cases of modified smallpox and invariably in the more aberrant forms of it. The sign, therefore, is of little value in diagnosis.

CHAPTER VI

THE ERUPTION AND THE ERUPTIVE FEVER

ALIKE in its outcrop and in its subsequent evolution, the eruption maintains a certain order of precedence. The first papule may come on the face, or on the wrist, or perhaps on the trunk of the body. Yet, in broad terms, the rash begins at the top and travels downwards, and invades the legs some twenty-four hours after its first appearance higher up. The lead so secured by the lesions on the face is maintained in their further development.

In the milder sorts of cases the whole rash may be out within twenty-four hours from the birth of the first papules. On the other hand, in severe cases even the lapse of forty-eight hours may hardly see the last arrivals. That is to say, the outcrop is a gradual process not only over the whole body but also on any one particular part. The papules first to come on the face are not only twenty-four hours in advance of those on the legs, but are also twenty-four hours in advance of the laggards on the face itself. Under such circumstances, the patient may exhibit on the first day of efflorescence a scanty rash on the face and upper part of the body only, on the second day a profuse rash on the face and a scanty rash on the legs, and not until the third day a rash of normal proportions in its incidence. (Plates XLVII. and XCIV.) As mentioned in Chapter IV., this consideration must not be lost sight of in determining the distribution of a papular eruption.

Confluent smallpox.—During the outcrop the toxæmic fever culminates. Between that time and the time of maturation there is, in a case of confluent smallpox, a striking metamorphosis of the patient. (Plates XLVIII. and XLIX.) At first he wears his normal aspect, altered only by the operation

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of the poison that is working in him. The papules of smallpox seldom itch much or cause appreciable discomfort, and in their size and appearance they bear no promise of the events which are in train. The rash, therefore, like the

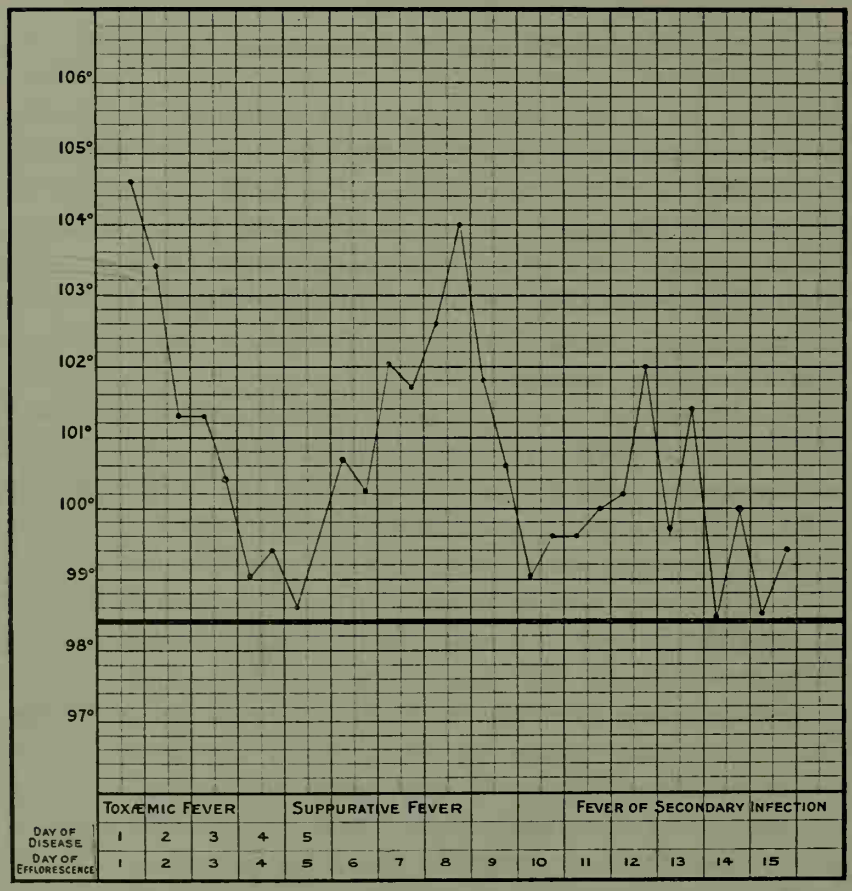

Chart II.—Discrete Smallpox with Severe Suppurative Fever. No Pre-eruptive Fever.

rash of measles, causes no symptoms and but little disfigurement; as yet it is itself but a symptom. If the transition were not seen, the subject of the early illness would not presently be recognised. In the period of suppuration the rash, which was once a symptom, has become the disease. It clogs the features, hampers the movements, and

enfolds the patient like a parasite. The difference in the symptoms and the aspect agrees with the double sweep of the temperature curve, and it is where the curve breaks that the character of the symptoms changes. (*See* Chart I., p. 4.)

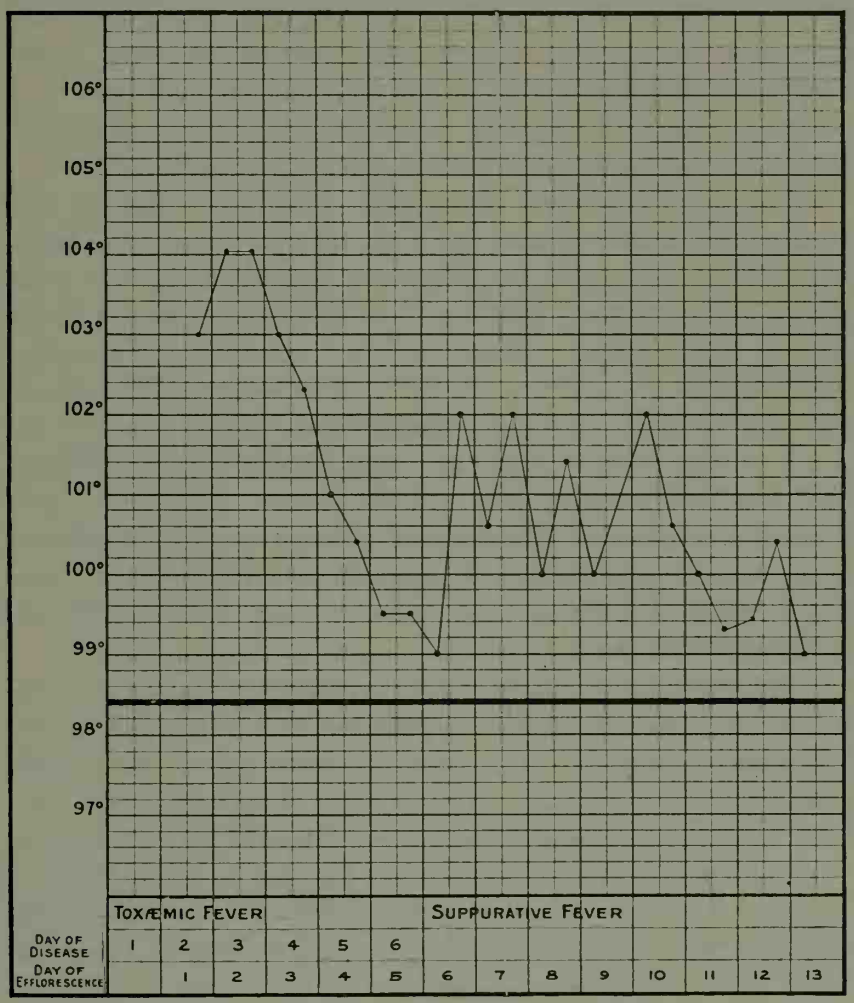

Chart III.—Confluent Smallpox with Moderate Suppurative Fever.

Evolution.—From the first state the patient passes by easy stages in which, bit by bit, the fever loosens its hold, while the rash gains more in prominence and begins to assert its domination. (Plates L., LI., and LII.) The lesions grow

and about the fifth day of efflorescence, when the patient feels at his best and may even have a normal temperature, his face and body are covered with large flat vesicles. Already the skin has begun to swell and feels stiff. The face looks as if covered with a grey caul, tight-fitting, with a broken surface, which partly hides but does not yet obscure the shape and play of features. The patient has freed himself from the symptoms of his first illness, but has not begun to taste the poison of the second, or yet to realise the obsession of the rash which will engender it.

It is variable to what extent the temperature falls in the stage of vesiculation, and on what day it is lowest. Most often, the lowest point on the curve is reached on the fifth day of efflorescence; but, nearly as frequently, on the sixth day or the fourth. (Charts I., II., and III.) Commonly, even in cases of confluent smallpox, at this dip in the curve the thermometer does not register more than 99°. But in some of the severer cases the recession is not so evident, and the temperature does not fall below 101° or 102°. With the progress of suppuration the curve of temperature again ascends and attains its acme on the ninth or tenth day of efflorescence or, it may be, earlier or later according to the severity of the case.

Maturation.—In most cases suppuration begins on the face on the fifth day of efflorescence, but is not fully developed there until the sixth. And it is not until nearer the eighth that the rash attains its maturity over the whole body. At that time a patient with severe confluent smallpox presents a very striking picture. (Plates XLIX., LII., Fig. 1, LIII., and LIV., Fig. 1.) The natural features are obliterated, partly by the rank growth of pustules, partly by the swelling of the skin below them. The face is bigger and broader, and the patient looks unnaturally aged. His orbits swell up, and the eyelids, and he peers out through the slits between them. The nose is thick and squat, like a bottle-nose; the lips are like a negro's, but immobile, dough-like. The cheeks are puffed out, and the ears are thickened. The play of features is paralysed by the mass which clogs their movements. The patient

mumbles when he speaks, and his voice is hoarse or whispering from the swelling of his larynx. The hands are swollen, and he moves his fingers like pegs.

To this loathsome, all-pervading rash the patient's fever

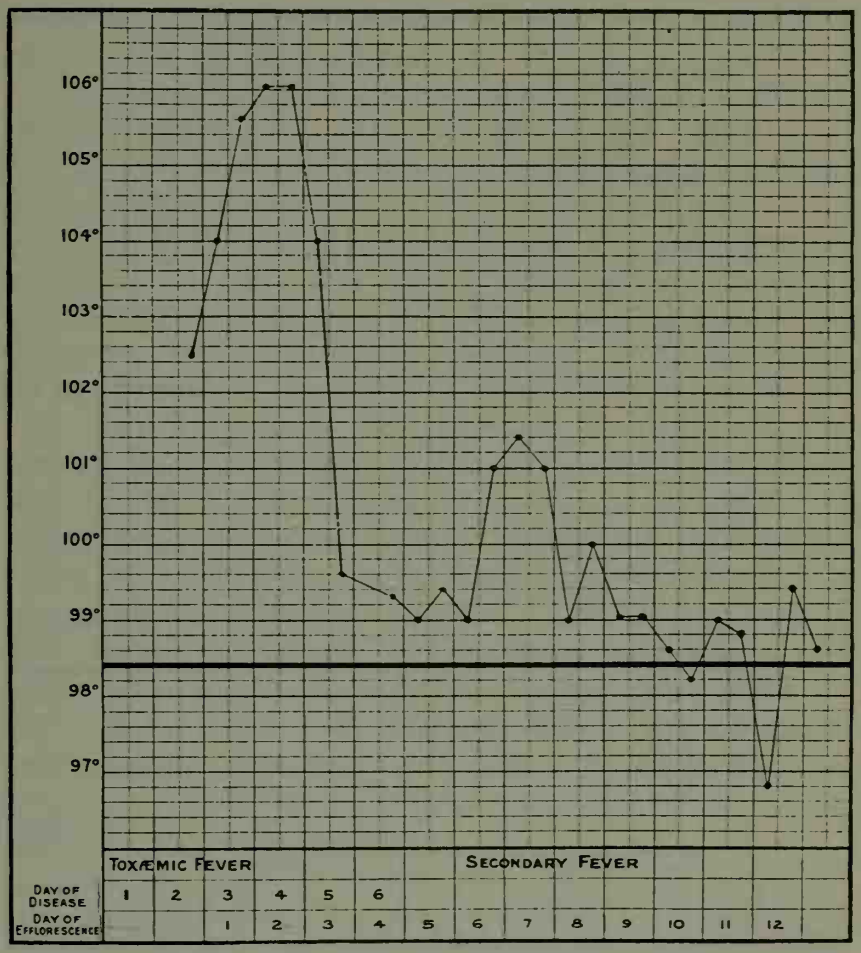

CHART IV.—SEVERE DISCRETE SMALLPOX WITH MODERATE SECONDARY FEVER.

and all his symptoms are due. The secondary fever is purely a suppurative fever, caused by the absorption of septic products from the pustules, and proportional to the amount of that absorption. Partly because the rash is most in plenty on the face, and partly on account of its greater vascularity, it is from the face that the absorption is greatest.

It is an observation of Sydenham, as true as it is old, that the patient's fever and his prospects of recovery are measured by the amount of suppuration which the face sustains.

The sweep of the curve of temperature of the secondary

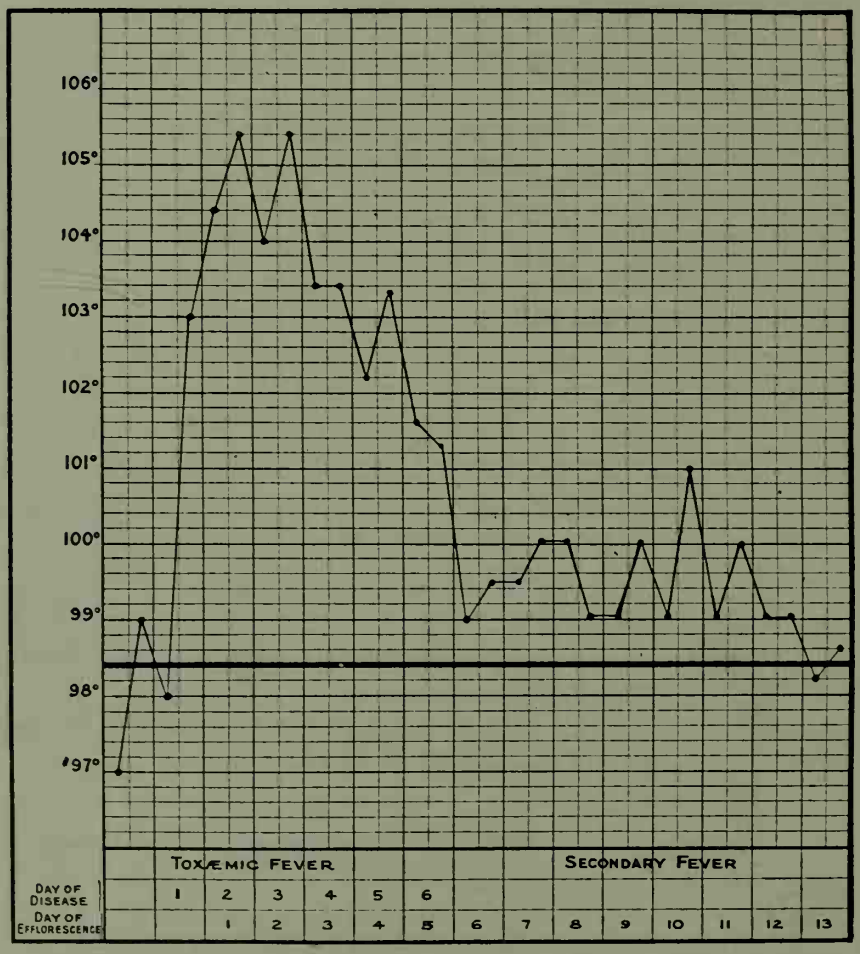

Chart v.—Confluent Smallpox Modified. Severe Toxæmic Fever with a Purpuric Rash.

fever is not so bold as of the primary. In the worst cases the temperature may exceed 105°. Yet in most cases of severity, including many fatal cases, it does not much exceed 103°; and in the great bulk of milder cases, whether the rash is discrete or confluent, it does not attain that limit. Smallpox in its sup-

purative stage is not, in fact, a highly febrile disorder; and the skin may suffer much disturbance and cause but a trifling pyrexia. With the milder sorts of discrete smallpox, febrile symptoms are hardly to be looked for; and with confluent smallpox, if the suppurative process is incomplete, as it is so often among vaccinated persons, the fever may be almost as insignificant. (Charts IV. and V.)

Involution and termination.—From about the ninth day of efflorescence, in the more favourable cases, the pustules dry up and scab over and, following this involution of the rash, defervescence sets in quickly. (Plate LIV., Fig. 2.) In the more serious cases pus, stained brown by altered blood, collects below the crusts formed on the surface and may exude from the broken pustules. (Plate LII., Fig. 2.) In the latter cases this period is the most critical; for the absorption of septic matter continues, the temperature remains high, and there is apt to be delirium which is often violent. In some of the worst cases of all, before there is time for incrustation to occur, there is extensive shedding of the cuticle. In these cases the rash is unusually profuse and the denuded parts, it may be the face, or the limbs, or the back, are such as are covered by a confluent eruption. Raw, weeping surfaces are thereby left exposed, and the cases are nearly always fatal. When death occurs during the suppurative fever the fatal day is, generally, between the eleventh and fifteenth of efflorescence. The fatal result is due, as a rule, either to septic absorption or to broncho-pneumonia set up by the affection of the air-passages.

Discrete smallpox.—Cases depart from the type which has been described in being either less or more serious. With confluent smallpox of the milder sorts, and with discrete smallpox, the domination of the rash is less pronounced and less sustained. (Plate LV., Figs. 1 and 2.) Discrete smallpox, unless by accident and except in infants, is not a fatal disease, and in cases of no more than moderate severity the secondary symptoms are insignificant. (Chart IV. and Chart VII., p. 64.) This is true of the vaccinated and unvaccinated alike. It must not be forgotten that even

among unvaccinated patients the eruption, though generally unmodified, more often than not is discrete. In such cases the individual lesions may be every bit as virulent as in a case of unmodified confluent smallpox; but they fail in their effect from lack of numbers. The peculiarities of modified smallpox are described in the next chapter.

ABERRANT ERUPTIONS OF CONFLUENT SMALLPOX

Confluent papular eruptions.—Cases of unmodified discrete smallpox, perhaps, give the least trouble of all in diagnosis. On the other hand, in cases of confluent smallpox the diagnosis is sometimes obscured by the very intensity of the attack. In most cases the epithet "confluent" does not apply until the stage of suppuration. Yet the rash is confluent, sometimes, even in the papular stage. The pustule may be taken to be of more than twice the diameter of the largest papule. The area occupied by the rash, therefore, increases more than fourfold. For that reason, to be confluent in the papular stage the lesions must be brought forth in great multitude, and such cases are almost always fatal. (Plates XLVIII. and LVI., Fig. 1.) The small red papules, each surrounded by its narrow areola and projecting but slightly above the surface of the skin, crowd into one another and lose their identity. The face looks fiery red, and shows an unbroken surface. The skin is thickened, but the particulate nature of the rash can hardly be perceived. The surface is but roughened, and feels like russian leather. This absence of discontinuity in the rash gives it a superficial likeness to that of measles. And the resemblance is not impaired by the fact that with smallpox the papules, though confluent on the face, may be distinct on the rest of the body; for that may be the case with measles also. In many cases a careful examination of the lesions on the trunk and limbs will disclose their proper character. Yet it often happens that the individual papules depart from the type so much that their nature is liable to be mistaken. The character of these aberrant lesions is very important

to recognise, and also the fact that they may be produced by somewhat different causes, and therefore may occur, not only in this, but also in some other types of cases.

Aberrant eruptions—causes and effects.—The character to be assumed by the lesions which may be developed in a case of smallpox depends upon two factors, the potency of the virus lodged in the skin, and the power of the tissues to resist it. In most cases of natural smallpox there is an equal fight. Some havoc is wrought by the poison; but there is a healthy resistance of the tissues shown by the effusion of serum, by cell-infiltration, and by other signs of inflammation. In some cases, where the immunity of the patient is high, the fight goes all in favour of the tissues. Repair predominates over destruction, and such lesions are met with as will fall to be described in the next chapter. In other cases the battle goes the other way. The virus is too strong, or the tissues are too weak. There is destruction of tissue and but little attempt at resistance. The tissues do not show fight, and the effect is seen in a soft papular rash and, later on, in flat and flaccid vesicles. (Plate LVI., Fig. 2.) There is little or no exudation of serum, and the vesicle is less like a bag of fluid than a superficial slough of the epidermis.

Such a lack of resistance as causes these sluggish lesions is met with in somewhat different groups of cases. It may be due to an overwhelming severity of attack, as in those cases of ultra-severe confluent smallpox described above. But it may be due, not so much to the virulence of the focal rash, as to the patient's constitutional condition; as, for instance, when a patient who sustains an attack of confluent smallpox is already the subject of a prostrating malady, such as tuberculosis. It is seen in those cases of hæmorrhagic smallpox in which life is prolonged into the eruptive stage. (Plate LXXXIX.) With hæmorrhagic smallpox the papular rash is not necessarily of the first degree of severity. Yet the character of the disease so swamps the patient's vitality that his tissues have no power to resist the virus which is deposited in the skin. Indeed the primary toxæmia of natural smallpox, if the poisoning be severe enough, will produce the same effect. It

will be seen later that in some cases the toxæmia is attended by the severest prostration. And while that prostration lasts, its effect is to occasion a similar want of reaction in the lesions. In such cases it is remarkable to observe, when the fever abates at the end of the vesicular stage, how the lesions swell up and take on a healthy reaction.

Just as deficient vitality in the patient is capable of altering the character of the lesions, so it may hinder their development. The change of the papule into the vesicle, and of the vesicle into the pustule, is due as much to the reaction of the tissues as to the action of the virus; and a feeble tissue-action may cause, not only anomaly of character, but delay in transformation also. The vesicle is late to come, and the vesicular stage is dragged out. In ordinary cases the interval from the birth of the papule to the advent of suppuration is about four days. In the cases under discussion the interval may be prolonged to five, six, or even seven days.

Smallpox is not suggested by an eruption consisting of a flush of soft papules, of a character more natural to measles, which change so slowly to flat, grey, sodden plaques, having little elevation, no serous contents, no umbilication, none of the characters proper to variolous lesions. That such cases are sometimes watched throughout their course, without suspicion of the real nature of the disease, would be less remarkable did not the distribution of the eruption so openly betray it.

CHAPTER VII

MODIFIED SMALLPOX

Immunity—natural and acquired.—By the use of the terms "modified smallpox" and "abortive lesions," no assumption is made as to the state of the patient with regard to vaccination. All that is implied is that he exhibits lesions which, in certain particulars, differ from the type most common among unvaccinated patients. The papules, instead of developing into the large vesicles and pustules of natural smallpox, are transformed into lesions which are generally smaller and often of a different conformation, which do not form pustules of the usual size or wholly fail to suppurate, and which hasten through their course of evolution more quickly than is natural.

The pathological significance of this kind of eruption has already been explained. There is a high power of resistance to the virus provoking the inflammation and, in consequence, processes of repair predominate over those of destruction. In other words, the patient is partly immune to the poison of the disease.*

But immunity may be exhibited in a different fashion. A patient's attack may be a mild one, not because the lesions display certain favourable characteristics, but because, irrespectively of the essential character of its elements, the rash itself is sparse. A patient's susceptibility is to be measured, therefore, not only by the presence or absence of modification of his lesions, but also by the numerical severity of his attack.

These different manifestations of immunity may occur conjointly, or the one independently of the other. A patient

* It is convenient to use the word "immunity" as a relative term, and not as synonymous with "complete insusceptibility to the disease."

may be immune by gift of nature or of art. If by art, the eruption is generally mild as well as modified; but not infrequently the rash, though modified, is yet numerically severe. When immunity is inborn, the eruption is generally mild but altogether unmodified. Yet it is important to bear in mind that, among the unvaccinated, there are some cases in which the rash is not only mild but modified as well (Plate LVII., Fig. 1), and others, more exceptionally, in which it is modified though numerically severe. It will be observed then, in the first place, that the term "modified smallpox" postulates nothing about numerical severity of attack, and, in the second place, that to confer immunity by vaccination is merely to produce, by artifice, a natural effect.

Influence of vaccination.—Almost all people are born susceptible to smallpox, though not equal in susceptibility. Among the unvaccinated the attack, in the bulk of cases, is of mean severity; most patients experience the severer forms of discrete smallpox or the milder forms of confluent. Those whose natural susceptibility diverges from this mean are fewer and fewer according to the extent of the divergence; and there are comparatively few of the unvaccinated who are liable either to the most severe or to the very mildest attacks.

Whatever his natural susceptibility may have been, when a person for the first time is vaccinated the immediate effect is such an augmentation of his natural immunity as to make him wholly insusceptible. With the lapse of years the immunity so acquired will wane, and after a sufficient interval of time will wholly disappear, leaving him just that modicum of natural immunity with which he started. Should he get smallpox then, he would get an attack of just that severity which he would have experienced had he never been vaccinated at all.

Now should such a person get smallpox in the interval, before his acquired immunity has worn away, he would be open to an attack of any degree of numerical severity up to the limit set by his natural immunity. He might even reach that limit yet still preserve a residuum of acquired immunity. A person, indeed, who has lost just so much of

his acquired immunity as to render him liable to smallpox of that numerical severity to which he was by nature liable, has by no means lost all his protection, and if he were attacked would have an eruption still considerably modified. The two faculties of the vaccinal immunity wane together; but the protective influence against numerical severity of attack goes quicker, and the faculty to cause an eruption to be modified is retained for years after the other faculty has been wholly lost. The duration of each kind of acquired immunity varies with different people. With some, immunity of both sorts is lost in less than twenty years; with others, traces remain for a lifetime.

The fact, that with the gradual attrition of vaccinal immunity the power of checking the numerical severity of attack goes first and the faculty of modifying the lesions lasts longer, has the notable consequence, already alluded to, that vaccinated patients often get eruptions which, though modified, are of considerable numerical severity. For, taking the large class of those who have lost their protection against numerical severity of attack but retain that against virulence of lesion, the members will be arranged after just the same plan as governs the severity of attack among the unvaccinated, and most of them will be liable to attacks of mean numerical severity. This does not imply that smallpox among the vaccinated is generally of mean numerical severity; for, in the still larger class of those who have not yet lost protection against numerical severity of attack, discrete smallpox predominates and swamps the severer cases in the former class. Smallpox of the vaccinated, therefore, differs from smallpox of the unvaccinated, not only in the preponderance of mild and modified cases, but also in the fact that even those who get the more severe attacks will be likely to exhibit more or less modified eruptions.

Confluent eruptions modified.—When a patient suffers an attack of smallpox with a well-modified, confluent eruption, the course of the illness is very surprising to the observer. It begins with a severe toxæmia, and the patient

gets a thick rash of papules which have no feature beyond the ordinary. There is nothing to dispel the shadow of threatened events. Not until the vesicular change is well advanced, or suppuration has begun, does the benign character of the rash declare itself. (Plates LVII., Fig. 2, LVIII., and LIX.) When suppuration sets in, the patient, who should be ill, feverish, and prostrate, whose bloated features should be covered with large, wart-like pustules, throws off his symptoms and is encumbered, but not enchained, by a rash which strews his face with a mere stubble of pus-capped pimples. (Chart v., p. 38.)

Nevertheless, modified smallpox may be a fatal disorder. For, in broad terms, the liability to death depends upon the measure of the total suppurative process. Unless the abortive character be very well marked, suppuration, though reduced in amount, is in modified lesions by no means absent. In a case of confluent smallpox, numerically severe yet slightly modified, the amount of suppuration may be the equivalent of that in a case of natural smallpox of a numerical severity which is only moderate; and this amount of pus-formation may be sufficient to determine a fatal issue in each case. The fact is, that it takes more rash to kill when the rash is modified, and that it takes more and more rash to kill according to the degree of modification.

Eruptions incompletely modified.—It must be understood that the character of the lesions is not necessarily uniform in a particular case. There is no distinct dividing line between modified and natural smallpox. In most cases of natural smallpox—whether the patient has or has not been vaccinated is immaterial—a minority of the lesions are small or abortive. (Plate XLVI.) In such cases the eruption is not described as modified, because there is an immense preponderance of lesions which are not atypical. When atypical lesions preponderate or contribute to the rash in large proportion, the eruption is said to be modified more or less completely. Modification is always most in evidence on the face, and it may be displayed by the bulk of the lesions developed in that situation when it is lacking to

those on other parts of the body. But these incompletely modified eruptions often exhibit, both on the face and elsewhere, the greatest diversity in the character of the lesions which exist side by side; some may be quite abortive, others only slightly modified, and others again may be natural. (Plates LX. and XL.) The kind of rash, which occurs in a case in which the whole vaccinal immunity has almost disappeared, is such a mixed rash of natural and modified lesions. It is that kind of borderland case which is so apt to be fatal if the rash is sufficiently abundant.

Characteristics of modified lesions.—The various types round which modified lesions may be grouped are to some extent characteristic of different cases, but in many cases lesions of diverse type are commingled.

When the eruption is in the papular stage it is seldom possible to distinguish modified from natural smallpox, and it is not until the lesions have become vesicular or pustular that the differences become manifest. In many instances the difference is almost wholly of size, and the lesions merely reproduce on a reduced scale the characteristics of normal lesions. (Plates LXI. and LXII., Fig. 1.) Sometimes this copying in miniature is carried to an extreme. The irritative action of the virus is then so slight as to evoke only an insignificant reaction of the tissues; and, though the lesions may not differ materially in shape from those of natural smallpox, they are much more superficial and very rapid in evolution. (Plate LXII., Fig. 2.)

Sometimes the difference is not so much in size or shape as in depth of situation only, and lesions are found which, while of moderate size, are obviously superficial and perhaps unloculated. (Plate LXIII., Fig. 1.) Lesions of this kind are peculiarly apt to occur on the soft skin of the trunk, and on those parts may sometimes be met with even in cases of natural smallpox.

With lesions of another type, though there may be differences from natural lesions in size and shape, the root-character of the difference lies in the inflammatory process. Under these circumstances the irritant which provokes the

lesion, though insufficient to cause so much destruction of tissue as in a case of natural smallpox, is nevertheless capable of evoking a very pronounced reaction which is displayed by the formation of new cell-tissue in the base of the lesion. These lesions lose, in part, the character of an abscess and take on something of the nature of a granuloma. They consist of fleshy elevations with shelving sides, and are deeply rooted in the skin. (Plates LXIII., Fig. 2, and LXIV., Fig. 1.) At the top of the mass there is a more or less imperfect vesicle or pustule. Though they are of a different structure, such lesions may be just as big as those of natural smallpox. They are developed chiefly on the face; and, in that situation, they are apt to leave wart-like excrescences which persist long after the recovery of the patient. (Plate LXV.)

Lesions of this peculiar nature are most characteristic when they are large. Smaller lesions of the same kind are less readily distinguished from some of the varieties already described, into which, indeed, they imperceptibly merge. Yet, especially on the face, even the more perfectly modified and smaller lesions are apt to take on something of the same character; that is to say, to assume the form of a cone-shaped fleshy base surmounted by a small vesicle or pustule. (Plates LXIV., Fig. 2, and LIX.) In some instances, no sign of vesiculation is ever apparent; and the lesion, though persistent, may be said never to advance beyond the papular stage.

Diagnosis.—The large lesions of the less modified eruptions have solid bases, well defined to the touch, and embedded deeply in the skin. Despite their different aspect, they are as easy of recognition as are the lesions of natural smallpox. Of the lesions which are smaller and more abortive it is harder to be sure. For, in proportion as they are more altered, their position in the skin is more superficial and they are lacking in those signs on which their recognition depends. It seems to be a law that the more susceptible the patient, the more deeply placed are his lesions. It is as though, with increasing immunity, the virus must escape further from the blood-bearing papillary layer and, under the least favourable conditions

can maintain itself only in those bloodless fastnesses of the upper epidermis near where the lesion of chickenpox inhabits.

In such cases many of the lesions have no characteristic by which it is possible to distinguish them from those of chickenpox. Yet, if the patient be seen before the pustules die and scab over, their real nature is generally betrayed by some of them. With a rash of scabs the thing is different, for nice distinctions of depth cannot then be appreciated. An added difficulty is that, since highly modified rashes signalise a high degree of immunity, they are commonest among children, because children are not too far advanced in years from the date of vaccination. And in the case of a child, on other grounds, chickenpox is often the most likely diagnosis. Under such circumstances, even when the rash is scanty, its distribution must be the cardinal factor in diagnosis.

Degradation of strain.—The severity of an attack of smallpox depends, really, on something more than the measure of the patient's immunity. For, with all infectious diseases and perhaps with smallpox more than most, the strain of disease varies in virulence in different epidemics; some are attended by a low fatality, others by a high. The severity of attack measures the resultant of the two opposing forces, the patient's immunity, and the virulence of the infective agent. The effect is that, in a mild epidemic, the proportion of mild and modified cases is much greater than in an epidemic of a severer type, and that the difficulties of diagnosis are proportionately increased.

From time to time we hear of epidemics in which the illness is so inconsiderable, and the eruption of so anomalous a character, that there is some hesitation about the name. If the rash be unlike that of smallpox, it differs equally from that of chickenpox, and opinion inclines sometimes one way and sometimes the other. There may be a temptation even to assume the existence of a third disease, and to invest it with points of distinction from each.

This flux of opinion is caused by the prevalence of smallpox of a very degraded strain of virulence. In every epidemic cases arise at intervals in which the eruption is so highly

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modified and the character of the lesions is so anomalous that there is an inadequate basis for diagnosis; and, given an epidemic mild enough, such cases may form the bulk. Yet it must not be forgotten that it is not possible for discordant distributions to run in series also. However much the lesions may be altered in character, the scheme of their arrangement will not be influenced either by the susceptibility of the patient or by the strain of the disease.

CHAPTER VIII

SECONDARY CHARACTERISTICS OF THE ERUPTION

THERE are certain features of the eruption which, though generally of subordinate interest, come occasionally into the first rank of importance. An example of a case in which these secondary characteristics determined the diagnosis is furnished by Plate LXVI. The rash was a syphilide. Though most of the usual distinguishing features were lacking, three facts may be deduced from the print, by which smallpox could be safely excluded. In the first place, many of the lesions were too large. Again, to some of these larger lesions there was lacking a regular circular outline. Lastly, the elements of the eruption were not homogeneous; the rash was composed, in part, of lesions which had become incrusted, in part, of smaller pustules.

Heterogeneous eruptions.—A want of uniformity of character in the lesions is a conspicuous feature, especially, of many cases of chickenpox. Yet, whether that disease or another is the alternative to smallpox, such evidence must be interpreted with discrimination. Merely that the eruption is heterogeneous does not count for much, for it may be heterogeneous with smallpox. The rapidity of evolution of variolous lesions is determined chiefly by their size and by their depth of situation. In cases of smallpox incompletely modified, cases in which the lesions differ considerably in point of size, they will differ equally in rapidity of evolution. There are cases of modified smallpox in which, for this reason, the want of uniformity among the lesions is a very conspicuous feature. (Plate LXIII., Fig. 1.) Papules arrested in development, vesicles, pustules, crusts may all lie together on the same square inch of surface. Moreover, even with natural smallpox the outcrop is a gradual process, and the firstborn

lesions get ahead of their neighbours and show a corresponding difference of character.

What is to the point is that with smallpox the diversity of character is orderly. The smaller the lesion, and the nearer it lies to the face, the greater should be its apparent age. In cases of chickenpox or of syphilis the diversity is fortuitous. The smaller vesicles or pustules may be intermingled with larger crusts; and the older lesions may be found upon the face, or upon the trunk, or upon the leg.

Rapidity of evolution.—The rapidity of evolution, the inconstancy of which is a cause of the heterogeneous character of certain variolous eruptions, is itself in some cases pertinent to the problem of diagnosis. Ordinarily the eruption is pustular throughout within eight or nine days of the outcrop, and on the face some two days earlier. The cases of smallpox in which those limits are exceeded are conspicuously distinguished by the severity of the constitutional symptoms and by the anomalous character of the rash. (*See* Chapter VI., p. 42.) Eruptions of ordinary character, consisting of vesicles wholly or in part, are therefore unlikely to be variolous if their age exceeds a week. Smallpox can be less safely excluded on account of undue rapidity of evolution. Only when the lesions approximate in size to those proper to natural smallpox can the rapidity of their maturation be adduced as rebutting evidence.

Shape and Size.—Marginal outline furnishes, sometimes, even more convincing evidence against smallpox than in the case quoted at the beginning of the chapter. The usual shape of the variolous vesicle or pustule is circular. A pear-shaped or asymmetrical outline is produced very frequently by a double or compound focus of origin; but such compound lesions are seldom difficult to distinguish. Not infrequent, also, are single vesicles or pustules with an outline which is slightly oval; these are met with most often in cases of modified smallpox. (Plate CVIII., Fig. 1.) But oval vesicles are, really, far more characteristic of chickenpox, the sign being secondary to the superficial situation of the lesion; indeed, the peculiarity is of some consequence in the differential diagnosis

of the two diseases. (*See* p. 119.) A distinction even more striking lies in the sinuous or jagged outline of many chickenpox vesicles. (Plate CVIII., Fig. 2.) Even though it may depart from the round, the outline of a variolous lesion is seldom otherwise than firm and regular. There are other diseases besides chickenpox with which an oval or irregular outline of the lesions may be a useful point of distinction.

Much less frequent are cases with which the size of the lesions is a material consideration. Yet there are some which, though most of the lesions come within the possible limits, may be excluded by the size of a few. Pustules or scabs half an inch across, or vesicles of a diameter even less, almost certainly would not be variolous. A downward limit of size cannot be fixed.

Blebs.—The dimensional rules apply only to the specific lesions. In the severer cases blebs may be developed and may attain a considerable size; but they are not specific and are never very numerous. (Plate LXVII.) They are caused by the detachment of the cuticle owing to the irritative action of the specific pustules. They are of little importance; for the specific lesions which have evoked the bleb can be readily discerned to lie within it, and there is, therefore, little risk of misinterpretation.

Proto-papules and lesions of inoculation.—There is, however, one form of variolous lesion which may be regarded as an exception to the rules in the matter both of size and of shape. In dealing with the outcrop and progress of the eruption, the events in its evolution are dated from the day when the papules invade the face in number sufficient to take account of. This invasion is generally sudden and distinct enough. Yet, sometimes, there are a few scouts which precede the vanguard of the army. A patient will point to one or two of his lesions and assert their appearance a day or two before the rest. These early arrivals come mostly on the face or upper part of the body. They start ahead of the rest in development and maintain their precedence. And, what is more noticeable, they are larger than the rest, often more deep-seated, and oval or a little irregular in outline.

From their size and shape and general appearance arises the suggestion that in some cases these proto-papules are lesions of inoculation. A patient who has become infected through the usual channel, the respiratory tract, still remains, during the period of incubation, susceptible to an inoculation through the skin. It may be that the evidence of inoculation is convincing, both from the history furnished, and from the fact that the lesions are exceptionally large and resemble the lesions of vaccination. (Plate LXVIII., Fig. 1.) Abnormal lesions of these kinds are enabling, sometimes, of an exceptionally early diagnosis.

Obsolescent lesions.—One may have to judge of a case of smallpox after recovery or during convalescence; what is all-important then is the impression which the rash has left upon the skin.

Crusts.—The crusts separate first from the face, trunk, and upper parts of the limbs. They linger longest beneath the thick skin of the palms and soles. On the soles, especially, they may persist for many weeks unless extracted artificially. These "seeds" have a very characteristic appearance. (Plate LXVIII., Fig. 2.) The thick cuticle of the sole lies over them and they do not interrupt its level surface. Through this translucent layer the brown disc-like scabs can be clearly discerned embedded in the skin below. This evidence is valuable, especially, in cases of the milder sort, in which scars and pigmentation-marks are absent or evanescent; for it may bring about a conviction when every other sign of the disease has failed.

Scars and granulomata.—It must not be supposed that even natural smallpox invariably scars, or that all parts of the body are equally liable to the damage. Scarring is most conspicuous on the face (Plate LXIX.), and is generally confined to the face or to the face and hands. In the worst cases the scalp is badly scarred and suffers a patchy alopecia. The parts that suffer most of all are the nose, the forehead just above the root of the nose, and the cheeks. In these situations, the patient often sustains a disfigurement which is even more trying than the broad deep scars themselves. There is

a fine pitting of the skin, which is relieved by the projection of points and strands of young scar-tissue, so that the surface is coarse and rough like a nutmeg-grater. (Plate LXX.) Such a condition is commonest among those who have had a confluent but partly abortive eruption.

An effect analogous to that last described, and one apt also to be evoked by a partly abortive rash, is the development of wart-like granulation-tumours. These were mentioned in the last chapter. (*See* p. 48, and Plate LXV.) They are most frequent on the jaws and cheeks and nose, and are seldom seen on other parts of the body than the face, except sometimes on the hands and forearms. These excrescences persist for many weeks, but are not permanent.

Desquamation.—Desquamation, in the sense in which the term is used in relation to scarlet fever, is not a symptom of smallpox. Yet, round the scar or mark left by the fallen scab, the cuticle often becomes partly detached and ragged. This effect is most in evidence where the cuticle is thick, for example, upon the limbs. It is brought about directly by the damage to the skin, and is confined to the immediate neighbourhood of the injury. Only the more deeply placed lesions provoke it. In severe cases, when the lesions crowd together, the effect may be pronounced (Plate LXXI., Fig. 1), but it is commonly absent or inconspicuous in cases of modified smallpox.

Pigmentation.—More characteristic are the areas of pigmentation which are left. (Plate LXXII.) When the attack has been moderately severe, the impression of the whole eruption is very clearly mapped out by them, and these spots of brown blood-pigment are very lasting. (Plate LXXIII., Fig. 1.) Where there are scars, the pigment forms a halo round each (Plate LXXI., Fig. 2); but in most places, and indeed in most cases, pigmented marks upon the surface are the only relics which remain.

In cases of natural smallpox, and in the severer cases of all kinds, by these scars and pigmented stains the disease can be told for many weeks after the patient's recovery. The distribution is as obvious as when the rash was mature. In

mild and modified cases the trail is not so plain. Scarring is absent, and even the pigment is evanescent. In such cases it is important to remember that the rash and its traces go first from the face, where repair is quickest. Observation must then be supplemented by inquiry to learn the true distribution of the vanished eruption.

SEPTIC RASHES

During the period of involution the skin is attacked, sometimes, by a superficial septic dermatitis. This is consequential to a septic infection of the pustules, and reveals itself as an erythema spreading at numerous points from the infective lesions as foci.

A secondary infection of the pustules by septic organisms is of common occurrence in all sorts of cases, but generally no harmful consequences flow from it. That in one case among many the infection should extend into the superficial layers of the contiguous skin is attributable to defective vitality of the tissues, due either to a pre-existing debility or, more commonly, to the debilitating effect of the disease. It is the same conjunction of causes as provokes such complications as boils, abscesses, and affections of the eye, to which these patients are very subject. All these secondary infections are most apt to appear just at the close of the suppurative fever, when they often give rise to a definite febrile attack which finds its record on the temperature chart. (*See* Charts I. and II., p. 4 and p. 34.)

The red patches, caused by the septic dermatitis, at first surround the infecting lesions after the manner of an areola. As the patches grow bigger they merge together and the skin becomes mottled by them. (Plates LXXIII., Fig. 2, and LXXIV.) There is no swelling of the skin, but in some cases small thin-walled vesicles and pustules are thrown out on the invaded surface, more especially on the flanks and abdomen. Those are, indeed, the favourite seats of the rash, and to them it may be confined; but in the more severe cases the best part of the body may be invaded. Sometimes especially when the

rash is extensive, it is apt to lose much of its mottled character, and large areas may be covered by a uniform or stippled erythema.

The affection, as indicated above, is accompanied by some fever and *malaise* and, it may be, by a sore throat. It is never dangerous. Its chief importance resides in the fact that it is liable to be mistaken for scarlet fever or measles complicating an attack of smallpox. Confusion with measles is less likely, but, if scarlet fever is a possible alternative, it may be very difficult to exclude it on the merits of the case.

CHAPTER IX

THE TOXÆMIC FEVER

Of this dual disease, the foregoing chapters have been occupied with that part, the focal rash and the secondary fever, which is generally the all-in-all both to the patient and to the physician. Yet, pathologically, that part is an excrescence on the other, a complication or a sequela. To the specific fevers themselves, the secondary fever of smallpox bears no analogy. The fever proper of smallpox is that of the septicæmia, and the focal rash and the secondary fever bear the same relation to it as the pneumonia to measles or the adenitis to scarlet fever.

The variolous septicæmia, or rather the toxæmia which it induces, though often insignificant in its symptoms and results, is still a serious phase of the illness. If natural smallpox could be shorn wholly of the fatal fever of suppuration, a disease would remain comparable to scarlet fever in its fatality. For the variolous toxæmia can be fatal enough, though it is the custom to classify the graver forms of it under the title of hæmorrhagic smallpox. These graver cases will be discussed in succeeding chapters, after the milder types of illness have been described and the toxæmic rashes which so often accompany them.

Symptoms.—The toxæmic symptoms are not very characteristic. There is every variety in their severity and duration, and they furnish scanty grounds for a guess as to the nature of the illness unless the patient is known to have been exposed to variolous infection. The symptoms do not differ materially from those of some other specific fevers or, indeed, from the symptoms of onset of several acute diseases. The toxæmic symptoms are not usually attributed to another specific fever unless associated with a toxæmic rash. They

are most commonly put down to influenza or to a common cold, from the symptoms of which they often present no distinguishing feature. Less often, and perhaps with less reason, the patient is supposed to be suffering from pneumonia, or acute rheumatism, or meningitis. Such misinterpretations are of little moment in the earliest stage of the illness, because the disease is seldom infectious before the outcrop of the focal rash. But sometimes they lead to the admission of a patient, suffering from smallpox, to the wards of a hospital or infirmary for other diseases.

Such an accident is most likely to happen when the illness is of some severity. In such cases the symptoms commonly prominent are a high temperature, severe frontal headache, and lumbar pain; and of these the last is the least constant. The range of temperature is, as a rule, higher than in the succeeding fever of suppuration, the ascent of the curve more abrupt but its height less sustained. A temperature of 103° is commonly exceeded; 104° or 105° is frequently reached, and not rarely 106°. (*See* Charts I. to V.) Attending these degrees of fever there is often a good deal of prostration, so that the patient, if not incapacitated, is unfit or disinclined for exertion. Most complaint is made of the headache, but sometimes that is dwarfed by the lumbar pain. From a good many patients the existence of pain in the back is elicited only by inquiry. Others complain of pain not so much in the back as in the limbs, or "all over"; occasionally it is concentrated in the chest or epigastrium.

The onset of illness may be abrupt, but is more often gradual. The symptoms are apt to come on in the night, the patient after much restlessness finding himself with a headache and, on rising, being attacked with giddiness and nausea. There is likely to be shivering, but rigors are exceptional.

The acme of the fever and of the symptoms is commonly reached on the second or third day of illness. In cases of moderate severity the duration of the toxæmia is from four to six days, the fever, the pains, and the prostration abating gradually during the latter part of that time. As the outcrop of the papular rash occurs most commonly on the

third day of illness, it will be observed that the outcrop is by no means coincident with the disappearance of the febrile symptoms and of the fever.

Among the other symptoms of the toxæmia may be mentioned vomiting; this is a common symptom, but it occurs only in a minority of the cases. Excessive salivation is sometimes noticed. Sore throat is generally absent. The tongue is thickly furred but is uncharacteristic. It is important to bear in mind that the eyes are generally suffused and may be faintly injected. This trait sometimes gives colour to a specious mimicry of measles, as is well brought out in Plate XCIV.

A very common and distressing mental symptom is sleeplessness. Delirium is less frequent, and is most apt to occur in the cases of children. Mental aberration is an uncommon complication, but one occasionally attended by serious consequences. It occurs independently of febrile delirium, is not accompanied by conspicuous pyrexia and, in fact, most often occurs in cases of little severity. The patient may be maniacal or melancholic. He has delusions. These may be successfully concealed, and the first warning of his condition, or even of his illness, may be an attempt at suicide.* These mental symptoms are generally of brief duration.

In some cases the illness is of still greater severity, the prostration alarming and the other symptoms proportioned to suit. The type of illness then approximates to that more commonly met with in cases of hæmorrhagic smallpox, and will be dealt with in a later chapter. On the other hand, in the milder sorts of cases the symptoms grade downwards, lose what little individuality they might possess, and become indistinguishable from those of many trifling disorders. In some cases of smallpox inquiry fails to elicit the history of toxæmic symptoms of any description. In others the duration is shortened; so that, sometimes, when the focal rash is observed, and it is likely to be insignificant and abortive, the

* A patient came under the writer's observation, whose illness was unsuspected until he was under arrest for attempting suicide by leaping into the Thames from the Tower Bridge.

precedent *malaise* has been forgotten, and the patient or the doctor fails to perceive the relation between the two events and misses the significance of each.

Incubation.—The incubation-period of smallpox is generally about twelve days counting to the onset of illness, or fourteen days counting to the outcrop of the rash. The length of this period varies within somewhat narrow limits, ranging from eleven to seventeen days reckoned to the date, not of onset, but of outcrop. Periods outside those limits are exceptional and should be looked upon with some suspicion.

Though it is illogical to do so, it is found convenient in practice to date the reckoning of the incubation-period to the outcrop rather than to the onset. This is so, partly because with the milder cases the symptoms of onset are apt to be vague and their commencement hard to define, and partly because, when the outcrop is taken as the determining point, the incubation-period is found to be more constant in duration.

Duration of the pre-eruptive period.—The interval between the onset and the outcrop is most frequently two days; that is to say, the outcrop occurs generally on the third day of illness. But the duration of this interval is very variable. The outcrop may occur on the day following the onset, or may be coincident with it. On the other hand, the interval may be protracted. It is very common for the outcrop to occur on the fourth day of illness. Sometimes it occurs on the fifth day, occasionally on the sixth, now and again, even as late as the seventh. (Chart VI., *see also* Charts I. to V., and VII.) 4, 34, 35, 37, 38, 64.

When the interval is much prolonged, the onset is apt to be more gradual than usual, the first symptoms being very mild and vague. The fact, that the duration of the incubation is more inconstant when the period is determined by the onset than when it is determined by the outcrop, suggests that when the pre-eruptive period is protracted the interval between onset and outcrop may have been prolonged at the expense of the interval between exposure and onset. A case

may, indeed, present evidence of the force of this explanation; as, for instance, when a patient falling ill on the tenth day after exposure nevertheless develops his rash, according to custom, on the fifteenth.

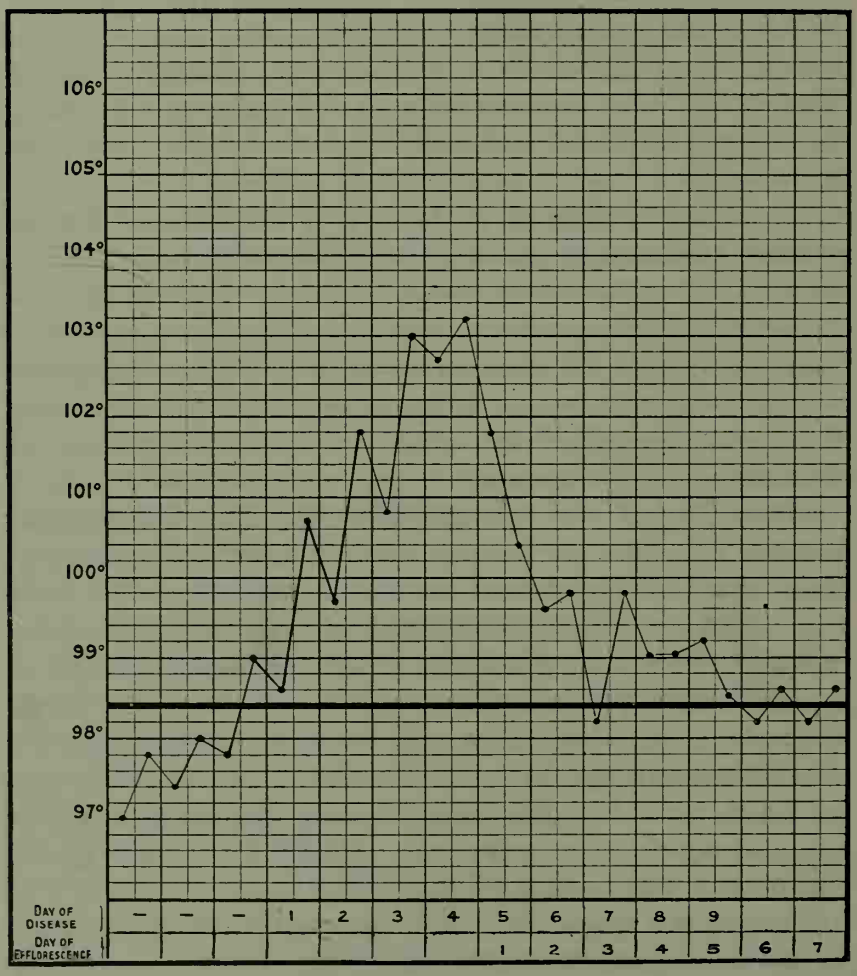

Chart vi.—Discrete Smallpox with Long Pre-eruptive Period.

In some of the worst cases, especially in some cases of hæmorrhagic smallpox, though the foregoing explanation may sometimes hold good, a protracted interval between the onset and the outcrop is due rather to the postponement of the date

of the latter event. In Chapter VI. it was pointed out that a toxæmia of exceptional severity has sometimes the effect of hindering the evolution of the lesions. And the same cause may conduce not only to a protracted efflorescence of the papules, but also to delay in their first outcrop.

Inter-relation of the toxæmic and suppurative fevers.—There is imperfect concordance between the severity of the toxæmic symptoms and the character and consequences of the focal rash. More often than not, a scanty focal eruption is preceded by mild toxæmic symptoms, and a plentiful eruption by a severe or at least a well-marked toxæmia. But exceptions are numerous in both directions. It is especially noticeable that a severe toxæmia is not infrequently followed by a rash which, if not insignificant in amount, at any rate induces an insignificant suppurative fever. (Chart VII., *see also* Charts IV. and V., p. 37 and p. 38.)

Such a fortunate concurrence of events is generally due to the partial disappearance of a vaccinal immunity. This artificial immunity not only has the effect of modifying the numerical severity of the focal rash and the suppuration of its lesions but, in addition, mitigates or abolishes the toxæmia. As, with the lapse of years, the two first faculties become gradually attenuated, so also does the last. But the process of attrition is not relatively uniform. The faculty retained longest, it has been pointed out, is that of preventing or modifying the suppuration of the lesions. That which is lost first is immunity to the toxæmia. It follows that vaccinated persons may have lost their artificial faculty of resisting the action of the toxins of the septicæmia, and may suffer a toxæmic fever mild or severe as determined by nature alone, and yet may exhibit a focal rash which, if not insignificant numerically, is insignificant in its effects.

Variola sine eruptione.—On this account it arises that, among the vaccinated, cases are to be encountered in which the focal rash is so disproportionate to the severity of the toxæmia that the nature of the disease is mistaken, because the observer, occupied by the toxæmic symptoms, disregards the rash which they obscure. Indeed, it is plain that a

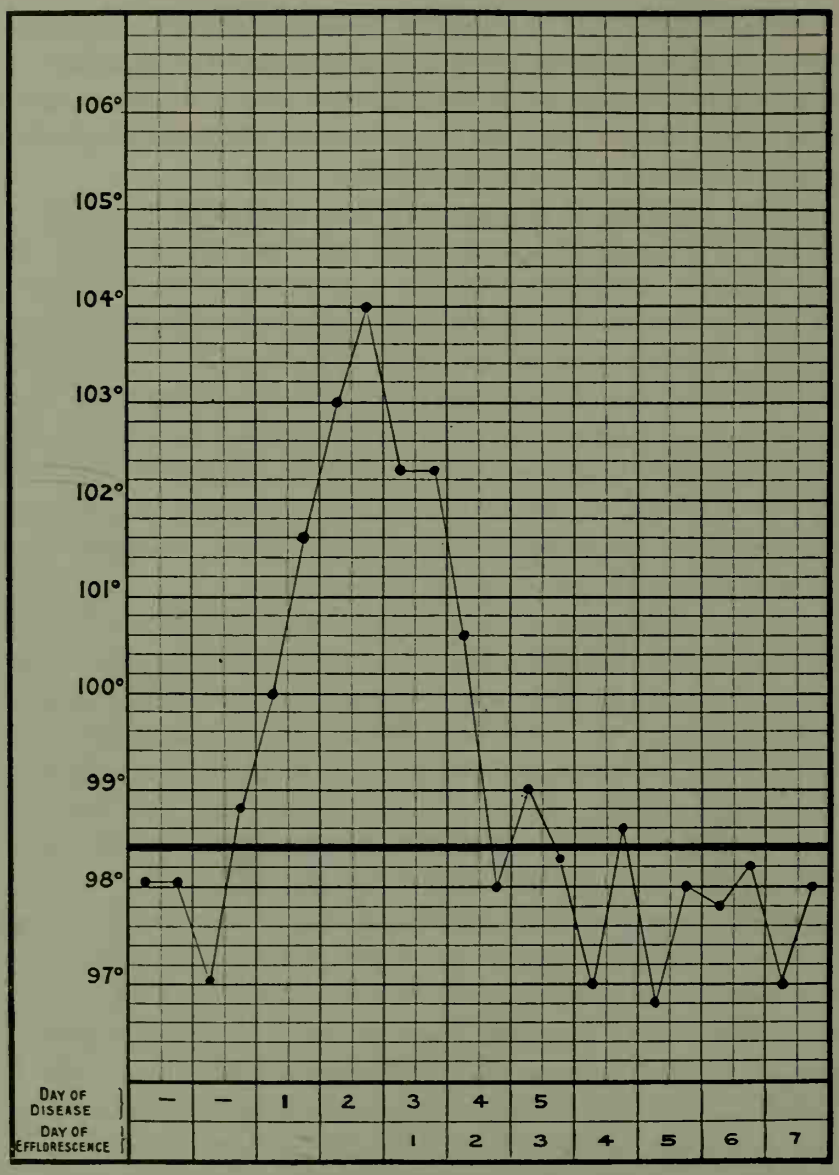

CHART VII.—DISCRETE SMALLPOX WITHOUT SECONDARY FEVER.

patient might develop a variolous toxæmia which would never be followed by efflorescence. (*See* Chart VIII.) Unquestionably such cases sometimes occur, but it is generally safe to neglect them since it seldom happens that the toxæmia is infectious.

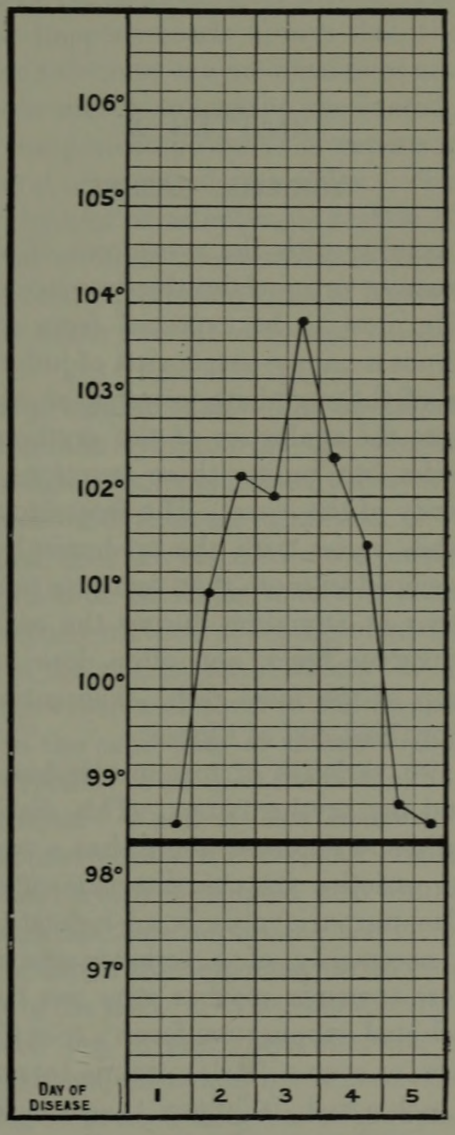

CHART VIII.—VARIOLA SINE ERUPTIONE AFTER SUCCESSFUL VACCINATION ON THE EIGHTH DAY AFTER EXPOSURE.

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CHAPTER X

TOXÆMIC RASHES

THESE rashes, coming with the symptoms of a specific fever, tempt one to suspect or proclaim the presence of a commoner exanthem. The most to be expected from a knowledge of them is sometimes a happy suspension of judgment.

The rashes of the variolous toxæmia, or, at any rate, one kind of them, are the analogues of the erythemata of scarlet fever and measles, but, unlike those eruptions, they are seen only in a minority of the cases. The frequency of occurrence of toxæmic rashes varies with the epidemic, but, generally, a rash is not developed in more than one case out of ten. The rash may appear at any time during the early and middle parts of the toxæmic fever, and often does not come until after the outcrop of the focal rash. The commonest time is on the second or third day of illness.

There are two varieties of toxæmic rashes, the petechial or purpuric, and the erythematous. This distinction is well-marked clinically and expresses more than a superficial difference. The two varieties are characteristic of different types of disease. The purpuric rash is an indication of a severe toxæmia; not necessarily of a serious attack of smallpox, because a severe toxæmia may or may not be followed by a severe focal rash and suppurative fever. (*See* Chart v., p. 38.) Though a severe, or even a fatal, toxæmia by no means necessarily induces such a rash, it follows that it is relatively more frequent in cases of hæmorrhagic smallpox. Yet it is frequently met with, also, in the less serious forms of the disease which do not themselves endanger life but cause, at the least, a noticeable illness.

The rose rashes, on the other hand, have no constant relation to the character of the toxæmia. For though the

toxæmic fever is generally mild among those who exhibit such rashes, it may yet be moderately severe. They are of good omen, because it happens nearly always that the subjects of them have either a discrete or a modified focal eruption. They are, therefore, seen mostly among the vaccinated. What they indicate is that the patient possesses or retains a considerable amount of natural or acquired immunity. The rose rashes, indeed, may be thought of as antitoxic rashes. Nevertheless, it will be seen in another chapter that a very similar rash to some of these occurs in certain cases of hæmorrhagic smallpox, but heralds death instead of recovery. (Chapter XIII., p. 98.)

Purpuric or petechial rash.—The development of a few petechiæ is a common symptom of the toxæmic fever. In cases of hæmorrhagic smallpox, indeed, this symptom is sometimes conspicuous. Yet such an exhibition of petechiæ, fortuitously arranged, does not constitute the purpuric rash. It is in the aggregation of petechiæ that this rash is peculiar, and especially in their method of arrangement.

The essence of the rash is that it affects the great flexures of the trunk, parts which seem ever to show a special tendency to blood-stasis in the capillaries of the skin and to capillary hæmorrhage. Probably in all cases the rash in its earliest stage is a simple erythema. When it is extensive in distribution and developed conspicuously, it consists of a dusky red erythematous background which is stippled with innumerable small hæmorrhagic extravasations resembling flea-bites. The vividness and depth of tint of the erythema varies from case to case and with the age of the rash. The petechiæ, being more persistent, may be seen for several days after the erythema has faded. The erythema, indeed, in many cases is very fugitive, and no more is to be noticed than a mere grouping of petechiæ on the areas affected.

The regions most favoured are the parts near the groins, and to that neighbourhood the rash often is limited. Its lower boundaries in many cases are curiously distinct, running slantwise towards each other across the thighs an inch or two below and parallel to Poupart's ligaments.

(Plate LXXV.) The rash seldom extends below the upper third of the thigh, even when developed most extensively and profusely. The upper limits are never so distinct. When the rash is pronounced it reaches upwards over the flanks and the abdomen to the armpits and the chest, being more vivid and closer set with petechiæ on the sides of the body than in front. When the rash comes into the armpit, it is apt also to stretch a little way down the inner side of the arm; it may even encircle the arm below the point of the shoulder, the arm passing through the cincture as through the sleeve of a bodice. Looked at from the front, the rash seems to clothe the patient like a vest and bathing-drawers. On the back the rash generally is undeveloped. In some cases, however, a band, sometimes narrow, sometimes broad, stretches like an apron-string across the loins (the flexure of the back) and connects the major part of the rash from flank to flank.

A rash so widespread is most pronounced in the recesses of the flexures, the groins, the hypogastrium, and the armpits (Plates LXXVI. and LXXIX., Fig. 1); and is developed most scantily on the chest and epigastrium. Yet it must not be supposed that the cases are numerous in which an area so extensive is covered. When the confines are narrowed, the rash comes only in the most favoured parts. In most cases it comes in the groins alone, or in the groins and hypogastrium, or in the groins and armpits. Less frequently it comes in the armpits alone. As a rule the rash is bilaterally symmetrical, but sometimes it is more pronounced on one side of the body than on the other. Occasionally it is unilateral, but in such cases it is never very abundantly developed.

The limits of distribution which have been defined apply more particularly to the purpuric elements of the rash. When an erythematous groundwork is present, the same limits apply, in general, to that also. Nevertheless, if the rash be very profuse, the erythema may overflow the normal confines of the rash and appear upon the back and limbs. In such case, the overflow which extends beyond the natural limits of the rash will be less vivid in colour and will not

show the wonted tendency to blood-stasis or to the development of petechial elements.

Effect on the incidence.—A peculiarity of the purpuric rash is that it has a tendency to shield from the invasion of the focal lesions those parts of the skin which it occupies. The evidence on which this conclusion is based is vitiated by the consideration that the favourite situations of the purpuric rash—the great flexures and the abdomen—are those parts, precisely, which the focal rash habitually shuns. Yet, after giving due weight to that circumstance, the fact remains that, when the purpuric rash is vivid and the focal rash abundant, the immunity to the latter of the area covered by the former is occasionally demonstrated with quite extraordinary distinctness.

The explanation of this peculiar effect is easy to understand. Pronounced purpuric rashes are developed, commonly, before the outcrop of the focal rash; and, if the capillary circulation in a certain part of the skin has become blocked before the precipitation of the agent which causes the focal lesion, the subsequent precipitation of that agent will thereby be prevented. (*See* p. 9.)

It may be mentioned that in rare cases the opposite condition occurs; that is to say, on that part of the surface where the purpuric rash is most vivid (generally in the groins) the focal rash becomes developed with unwonted profuseness. It is impossible to determine what circumstances unite to secure such a result; but probably, during the changes in the capillary blood-current consequent upon the incidence of the purpuric rash, changes which range from the normal condition of the circulation down to complete stasis, a favourable, though transient, state of flow happens to occur at a particular time when the active agent in the blood is ripe for precipitation.

Diagnosis.—From the peculiar character and disposition of this rash a case of smallpox may be recognised, sometimes, even before the outcrop of the papules; or, again, the rash may be a confirmative element in the diagnosis after the focal eruption has appeared. Unfortunately the purpuric rash may be mistaken for the rash of scarlet fever. In severe cases of that disease the erythema exhibits, occasionally, on the fore part of the trunk a character similar to that of the variolous rash; that is to say, it is dusky in tint, sluggish in

reaction, and flecked with petechiæ. The distinction between the two lies in the peculiar delimitation of the variolous rash, in its sharp line of demarcation on the thighs, in its greater purpuric tendency, and in the absence of the distinctive signs of scarlet fever.

Rose rashes.—These erythemata are deficient of the fixed character and individuality of distribution of the purpuric rash. Of one kind the seat of election is the trunk of the body (Plate LXXVII.), to which part the invasion may be limited; but in other cases the rash extends on to the limbs. There is a second type which has a special preference for the limbs, particularly for their distal ends and extensor surfaces. (Plate LXXVIII.) Neither kind of rash has any special affinity for the face, though they may invade it. The presence of one of these rashes is not necessarily a bar to the development of a purpuric rash in the flexures, but the two sorts do not often come together.

When the rose rash is of the more general distribution it consists of a bright erythema, which causes no thickening of the skin, has little or no tendency to cause blood-staining, and is often fugitive. The erythema may be uniform and unbroken, but frequently it is composite or particulate. In the latter case it may be punctate, like the rash of scarlet fever, or of coarser texture, more nearly resembling that of measles. Sometimes the erythema has a still more broken character, being interrupted by small or large areas of white skin which give the rash an irregular splash-like character.

The other form of rose rash is limited in most cases to the limbs, in many cases to the arms, and occasionally to the legs only. In typical cases the rash comes up about half-way on to the upper arms, and on the legs extends above the knees. It is made up of red discs with a well-defined edge, in size and colour like the vesicular areola. (Plates LXXIX., Fig. 2, and LXXX.) Below, on the backs of the hands, wrists and forearms, or on the shins and the dorsa of the feet, the spots run together to make a sheet of even redness. Where the rash creeps round on to the flexor surface of the

limb, and higher up towards the elbow or the knee, the rash thins out and the elements become distinct. This erythema is commonly darker in tint than the rose rash previously described, and it is less labile. It is apt, therefore, to be somewhat more persistent, and, when it fades, to leave a slight yellow staining of the skin; but it does not become purpuric.

In some cases the rash last described has a wider distribution, covers all the limbs, and invades the trunk. (Plates LXXXI. and LXXXII.) Since, therefore, the one kind of rose rash may extend from the trunk and cover the limbs, and the other may spread from the limbs over the body, it is obvious that in some cases the distribution will be indifferent. In most cases it is not difficult, by observing the seat of election of the rash and the character of its elements, to determine to which group it belongs. But the discrimination is superfluous, since both have the same clinical significance.

Diagnosis.—These rashes are a prolific source of confusion. Occasionally they are attributed to scarlet fever, but much more often to measles. The kind last described, which prefers the limbs, should be distinguished from the rash of measles without much difficulty, for their affinities of distribution are opposite. The other kinds, also, have some points of distinction from measles, but these would be of more value were not the temptation to ignore them so often overwhelming. An interrupted erythema, constitutional symptoms suggestive of a specific fever and, as likely as not, suffused eyes or faintly injected conjunctivæ,—with such a conjunction of symptoms there is a temptation to ignore a discrepancy in the anatomy of the rash and in its distribution. The chief difference in distribution is that the variolous rash does not, generally, affect the face; or, if the face is affected, the rash shows no discontinuity of surface there, and no special choice for the skin behind the ears, and over the temples, and among the hair-roots. The variolous erythema is apt to be irregular in distribution, irregular in the profuseness of its development and in its depth of tint, and lacking in uniformity of composition. It

differs in elementary character from the measles rash, if not on all parts, at least on some; the erythema being too fine in texture, or too coarse, or too patchy, and the skin affected by it not being thickened or raised.

Confusion with scarlet fever is less frequent, though the resemblance of the rashes may be closer. The distinction, in fact, in most cases is easy to make by an examination of the mouth and throat and glands.

CHAPTER XI

HÆMORRHAGIC SYMPTOMS

THE key to a clear conception of this phase of the disease is to remember that hæmorrhage from smallpox is not synonymous with hæmorrhagic smallpox.

A patient may be said to suffer from toxic or hæmorrhagic smallpox when his life is menaced by the toxæmia.* An analogy is furnished by scarlet fever. Cases of that disease are encountered, which are dominated by the constitutional rather than by the local symptoms. Such cases are called toxic cases. They are signalised by a rash which shows a marked aptitude for blood-staining, and they go on rapidly to a fatal issue. They are in contrast with cases in which the angina is pronounced, and death, if it occurs, follows from septic absorption. Those two groups are analogues of hæmorrhagic and confluent smallpox. Hæmorrhagic smallpox is toxic smallpox, and in this volume the terms are used indifferently.

In separating for convenience of description a group of cases which conform to an imaginary type, it must be remembered that the practice is arbitrary. Hæmorrhagic or toxic smallpox has no peculiarity which is essential. No fixed line separates the toxic from the less serious cases, but there is a gradation from the milder cases up to those in which death descends with relentless rapidity. It follows that symptoms of hæmorrhage cannot be regarded, as the name hæmorrhagic smallpox would seem to imply, as the

* It is sometimes convenient, for statistical purposes for example, to use a definition which is more exact. It is then, perhaps, best, in the present state of our therapeutics, to restrict the terms to those cases which are fatal from the toxæmia, or from some condition (such as œdema of the lungs) which the toxæmia has induced.

hall-mark of a peculiar type of disease; and it will be understood that this chapter is devoted to the description, not of a type of disease, but of a group of symptoms.

Hæmorrhagic symptoms are due, doubtless, to the circulation of a specific poison or toxin. The sequence is not peculiar to smallpox; it occurs in cases of hæmorrhagic diphtheria, of toxic scarlet fever, of pneumonic plague, and from some kinds of snake-bite poisoning. The toxins incidental to those different maladies differ in their ability to cause hæmorrhage; that of smallpox is peculiarly apt, and death from the variolous toxæmia is almost always preceded by hæmorrhagic manifestations.

The hæmorrhage itself is seldom dangerous. It is important as an expression of the operation of the toxin. Yet, from case to case, the toxin operates with unequal effects. Its precise action will depend, not only upon the dose, but also upon the patient and his vital weaknesses. In one case the bleeding will be chiefly from the air-passages, in a second there will be hæmaturia, in a third cutaneous hæmorrhage only. Moreover, of two patients equally severely poisoned, in one case the hæmorrhagic symptoms will be masked, in the other they will be pronounced. The significance of the different hæmorrhagic symptoms will depend, therefore, not only upon the kind and degree of hæmorrhage, but equally upon the other symptoms with which they are associated. Many patients, not desperately ill, exhibit hæmorrhagic symptoms of a sort; and, indeed, in almost all cases of smallpox there can be discerned the trail of the special faculty to bleed.

Post-toxæmic hæmorrhage. — The extravasations are secondary, it may be supposed, to some damage suffered by the vascular endothelium or to some injurious action of the toxin on the vascular mechanism. Such damage can be effected only while the toxin is circulating in the blood; that is to say, during the toxæmic fever. Yet the effect of the damage, the liability to hæmorrhage, may remain with the patient even after the elimination of the toxin has been fulfilled. Patients, therefore, who have passed through the toxæmia

and entered upon the separate hazards of the secondary fever, may still exhibit signs of the hæmorrhagic tendency. A slight injury, which would be innocuous in health, may cause a blood-effusion in a patient whose vessels are already weakened by the disease. Thus patients with smallpox are exceptionally liable to bruises, even during the period of suppuration.

Another sign is so common that it may be observed in almost every case. The focal lesion, it will be seen presently, is an injury so potent that in the severer cases it may determine a bloody extravasation about itself long before its maturity. When the patient is less severely poisoned, a premature lesion does not have that effect; but as the lesion ages, and grows, and suppurates, and destroys the tissue about it, the stimulus gathers force: and at last, even in the milder cases, excites an extrusion of hæmocytes from the vessels, which may be unnoticed at the time, but leaves its record in the pigmented area which surrounds the scar. (Plates LXXI., Fig. 2, and LXXIII., Fig. 1.)

In some cases the extravasation is obvious before the pustule has become encrusted. It is not uncommon in cases of confluent smallpox, more especially on the arms and legs where the stimulus of the lesion is supplemented by the movements of the limb, to see some of the pustules with blood-stained contents. (Plates LXXXIII. and LXXXIV., Fig. 1.) Occasionally these hæmorrhagic pustules are displayed, even in cases of discrete smallpox, over a considerable area of the body.

Yet all these tardy evidences of the tendency to bleed are wholly devoid of significance. They are but the foot-prints of an illness which has passed.

Toxæmic hæmorrhage.—Other factors being equal, the greater the dose of the toxin, the earlier and the more readily will become manifest its capacity to provoke hæmorrhage. Therefore a hæmorrhagic symptom, developed during the course of the toxæmic fever, assumes at once a certain clinical significance.

Yet many of these manifestations are not of serious omen.

It is a general rule that bleeding from internal structures or surfaces is more serious than external extravasations. Some kinds of cutaneous hæmorrhage are, in fact, so common that they may be regarded as ordinary symptoms of the toxæmia. One such symptom is the exhibition of the purpuric or petechial rash, which was described in Chapter X. and will be referred to also in a later chapter. Petechiæ, again, not specially grouped, but scattered fortuitously and often sparsely over the surface, are apt to appear on the skin of the trunk and upper parts of the limbs with all the severer sorts of toxæmia, especially in the cases of children.

A graver, but not necessarily a fatal sign is the development of small round or oval extravasations, clear-cut and counter-sunk. (Plate LXXXIV., Fig. 2.) In this instance, also, children are the favourite subjects. These spots are seldom bigger than a split pea. Their colour ranges from violet to black, according to the depth of tissue occupied. Usually they are sparingly developed. They choose the parts most apt to display petechiæ, with which they are often associated.

Of more serious omen still are cutaneous extravasations occurring in streaks and patches. Such blotches are irregular in outline, and inconstant in depth of tint. They may appear on any part of the skin, and may attain a considerable size. If, in a case of toxic smallpox, an erythematous rash is developed, it very readily becomes streaked or mottled by such areas of discoloration. Yet a toxæmic rash, presenting such a character, is not necessarily of the most serious significance unless the colour is very dark, that is to say, deep purple or black. (*See also* Chapter XIII., p. 98.) Hæmorrhage of this sort is to be regarded the more seriously when not excited by a coincident erythema.

Toxic smallpox causes the blood to coagulate imperfectly. Hence a scratch, or a trifling abrasion of the skin, is very apt to be marked by a continuous or interrupted oozing of blood from the broken surface.

Extravasations about the vesicles or papules are among the most frequent of hæmorrhagic symptoms.

The areola is more prone to be affected than the lesion itself. Sometimes it is only to be observed that the colour of the areola is immobile; and when it has faded, that it has left its record in blood-pigment. But when the vessels are more impaired, the areola acquires a violet or purple tint from the excessive effusion of blood. (Plate LXXXV.) Blood-stained areolæ may be developed over the greater part of the cutaneous surface, but are seen most often on those parts of the body, such as the shins, where the circulation is slow.

Either alone, or in conjunction with the staining of the areola, an extravasation may occur into the vesicle itself; and the latter is the more serious sign of the two. The effusion may be directly into the cavity of the vesicle, which turns black from the blood which distends it. But that event is relatively uncommon, and at the most but few of the vesicles are so affected. Generally the effusion takes place into the tissue at the base of the vesicle. The colour and ocular definition of the effused blood are then obscured by the superjacent lesion; and unless the extravasation is very pronounced, it looks indistinct, as though seen through a bluish haze, like a stained object out of focus in the microscope. (Plate LXXXV., Fig. 2.) These subvesicular effusions are among the commonest of the hæmorrhagic signs of the toxæmia. In some cases—and in many of these the toxæmic fever is not especially serious—only a few vesicles are affected; but at the worst the extravasations are very prominent and cover the patient from head to foot, obscuring the whole character of the rash. It must be remembered that the number and prominence of these extravasations are not sure guides to the probable issue, and that in many cases of toxic smallpox, fatal in the vesicular stage, the sign is relatively inconspicuous.

The papules are not so liable as the vesicles to become the foci of hæmorrhagic extravasation. The papule and the papular areola sometimes become blood-stained; less frequently, the papule becomes capped with blood. (Plate XCI.)

The significance of a hæmorrhagic effusion varies in proportion as it is spontaneous, and not accidental or factitious. Subcutaneous hæmorrhage is, therefore, not necessarily of serious omen. Not infrequently a bruise can be traced to some injury, and all patients with smallpox bruise easily. But the significance of the bruise increases with the disproportion between cause and effect; and multiple bruise-like effusions are sometimes the most prominent feature of a case of toxic smallpox. In many cases subcutaneous extravasations occur which are not so pronounced as to cause discoloration of the skin; but they can be discerned beneath the surface as indistinct vein-like markings.

A favourite situation for effusion of blood is the orbit. The effusion may even be so extensive as to cause distinct proptosis of the eyeball. Still more common is extravasation into the ocular conjunctiva. The effusion assumes a triangular shape, the base of the triangle lying against the cornea. Conjunctival hæmorrhage may be one-sided or double. It may be developed both on the inner and on the outer side of the cornea, and in the worst cases the whole of the conjunctiva becomes filled with blood. Conjunctival hæmorrhage, unless very pronounced, is not to be regarded with despondence. It is among the least serious of the hæmorrhagic symptoms.

While hæmorrhage from within is, in the main, to be regarded more seriously than extravasations on the surface, the evidence must still be used with discrimination. Perhaps the most common of these symptoms is uterine hæmorrhage. But all forms of the toxæmia have a tendency to induce prematurely the menstrual flow; and if the patient is pregnant, a toxæmia of even moderate severity is capable of causing abortion. It is not surprising, therefore, that when women get toxic smallpox, repeated or continuous uterine hæmorrhage should be the rule. Again, epistaxis is a common symptom of toxic smallpox. But when the patient is subject to epistaxis, or is a child, the symptom is to be regarded differently from repeated or continuous bleeding from the nose when the patient is a

stranger to that symptom. Similarly, a little oozing from the gums need not be taken very seriously; but a dark bloody extravasation into the mucous membrane of the fauces, the palate, and the root of the tongue, is a common and characteristic symptom in toxic cases.

With rare exceptions, only in toxic cases do other kinds of internal hæmorrhage become prominent. Hæmoptysis is common; generally it comes on late in the toxæmia, and is a sign of congestion or œdema of the lungs. Hæmatemesis occurs with frequency in cases in which it cannot be ascribed to the swallowing of blood poured out from the nose, or throat, or lungs. Melæna is less common, but by no means rare. A symptom, one of the most frequent of all, is hæmaturia. In this connection the word does not imply merely the passage of "smoky" urine, but the voiding of fluid of the colour of port wine.

Prognosis. — Extravasation into the faucial mucous membrane, severe or continuous hæmoptysis, hæmatemesis, hæmaturia, continuous epistaxis, multiple spontaneous bruises, purple cutaneous extravasations, numerous extravasations about the focal lesions,—when there is a combination of some of these symptoms, the patient very seldom recovers. But the significance of any one of them is much reduced if it stands alone, and it is seldom safe to forecast the issue from the hæmorrhagic symptoms only. This is still more true if the hæmorrhage is less pronounced, or of the less serious kinds; in such cases, and they are many, all hangs upon the nature of the coincident symptoms.

CASES WITH SYMPTOMS OF HÆMORRHAGE

The following cases have been selected to illustrate the variety of hæmorrhagic symptoms which may be displayed, the variety in the course of the illness, and the variety of result. The collection does not reflect the frequency with which cases of different degrees of severity occur in practice, but indicates a scale of severity, any note of which may be struck by a particular case.

Case I.—Confluent smallpox with subvesicular hæmorrhage—Recovery.—A. H., a man aged 38, was stated to have been vaccinated in infancy but had no cicatrices. During the first two days of illness the symptoms were of so moderate a character that the patient kept his bed against his inclination. The outcrop of the papular rash occurred on the third day. Thereafter, there was a great deal of prostration and considerable toxæmic pyrexia; by the sixth day of illness the patient was very ill and highly delirious. The rash was confluent on the face, but not of excessive numerical severity. The lesions were soft, and slow in evolution; the areolæ were of a dull red colour and sluggish in reaction, and on the legs were for the most part altogether immobile. When the rash had become vesicular, it was very noticeable that hæmorrhage had occurred in the bases of a large number of the vesicles. The purplish staining of the lesions, so caused, was apparent on the face, but was more conspicuous on other parts of the body. It occurred on the trunk, arms, wrists, and legs, but was worst on the feet. In some parts only at intervals was a vesicle stained, but in other places a large proportion of them. The general effect was that, especially on the limbs, the rash was extensively discoloured. There were no other hæmorrhagic symptoms, and on the eighth day of illness the other symptoms abated. The succeeding fever of suppuration was not very severe, and the patient made a good recovery.

Case II.—Toxic smallpox—Subvesicular hæmorrhage—Death from œdema of the lungs.—C. W., a man aged 32, was vaccinated in infancy and had two cicatrices. He died on the eleventh day of illness. The toxæmic symptoms were pronounced, but not of the first severity. Towards the close of the illness the patient became delirious. The outcrop occurred on the fourth day. The rash was extremely profuse, and on the face was superconfluent. In its earliest stage it was of a vivid red colour, which could be discharged only imperfectly by pressure and on the legs was quite immobile. The papules were soft; and when the lesions became vesicular, they were still limp and were slow in evolution. On the legs subvesicular hæmorrhage developed extensively; the backs of the feet and the shins were covered with plum-coloured vesicles. The ulnar sides of the forearms became similarly affected, though the colour in those situations was not quite so deep as on the legs. There were no other hæmorrhagic symptoms. On the ninth day of illness the rash on the face had become pustular, the pustules being small and distinctly modified. But on other parts of the body the vesicles showed no sign of modification, and presented the same flat, limp character as before. In some places the cuticle had peeled off, and large raw surfaces were so exposed. Towards the close of the illness the patient developed œdema of the bases of both lungs, and rapidly became cyanosed and died.

Case III.—Toxic smallpox—Death on the tenth day of illness from pneumonia.—P. G., a boy aged 8, unvaccinated, fell ill with symptoms of gradually increasing severity, and became delirious on

the third day of illness. The patient was quiet in his delirium, but it persisted until his death. The focal rash appeared on the third day, and was very abundant. The colour was vivid and not very labile. When the rash attained the vesicular stage, many of the lesions presented a purplish subvesicular staining; this appearance was most noteworthy on the thighs. The first decisive sign of the gravity of the illness was a fetid odour of the breath, first noticed on the fifth day of illness. But, earlier, some small pink petechiæ had been noticed scattered about the body, and also a few larger cutaneous hæmorrhages about a tenth of an inch across; most of the latter were violet in colour, but two of them were purple-black. On the sixth day of illness the boy began to spit up blood-stained mucus, and there were some signs of œdema of the lungs. A bruise half an inch across appeared on the forehead. During the succeeding days the patient seemed better. The odour of the breath became inoffensive, the expectoration ceased to be blood-stained, and there was normal evolution of the eruption. But in the end the child developed pneumonia and died.

Case IV.—Toxic smallpox—Œdema of the lungs—Recovery.—It has been pointed out that, though the symptoms of hæmorrhage are an expression, they are not necessarily a measure of the severity of the toxæmia. In this case these symptoms were conspicuous; but though the other toxæmic symptoms were by no means insignificant, the case was exceptional, not so much because the patient under those circumstances survived, as because she survived also the pulmonary complication which is so generally fatal. On the third day of her illness the patient, L. B., aged 27, unvaccinated, developed a papular rash which afterwards became confluent. On the legs many of the areolæ became blood-stained; and here and there about the body and limbs, hæmorrhage occurred in the bases of some of the vesicles. On the sixth day of illness there was an attack of epistaxis. Some extravasations appeared on the hard palate, and the fauces became black and foul from effusion of blood into the mucous membrane. On the seventh day a large conjunctival hæmorrhage developed in the left eye, and the patient began to cough up blood-stained mucus. She continued to expectorate large quantities of blood-stained fluid, but on the tenth day of illness the secretion ceased to be blood-stained. Thereafter, the œdema of the lungs cleared up, the patient developed a normal secondary fever without further complications, and made a good recovery.

Case V.—Toxic smallpox—Death on the tenth day from œdema of the lungs.—A. A., a woman aged 38, had been vaccinated in infancy but had only one very small cicatrix. The onset of the illness was very sudden, the pain violent and lasting, and the prostration extreme. Except for a few hours during the night of the sixth day, the mind remained clear throughout the illness. The outcrop occurred on the third day, and the rash was abundant. The colour of the papules and

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areolæ was dark red, and was imperfectly mobile. The subsequent evolution of the eruption was slow and imperfect, the vesicles, when formed, being flat and limp, and showing no sign of suppuration until shortly before death. On the fourth day of illness a petechial rash appeared in the groins and armpits; additionally, many petechiæ and a few larger extravasations were scattered irregularly about the trunk and upper arms. Epistaxis set in on the sixth day: the patient was subject to this symptom, but the bleeding was unusually severe and continuous. About the same time, uterine hæmorrhage developed; and it was noticed also that the focal rash displayed some subvesicular hæmorrhage. On the eighth day there was some hæmoptysis. On the following day the patient rallied, and the epistaxis ceased. But she had developed œdema of the lungs, and on the tenth day of illness was expectorating large quantities of watery fluid. The respiration increased in rapidity, and the patient became cyanosed and died.

Case VI.—Toxic smallpox—Profuse papular eruption—Death on the seventh day of illness.—J. A., a married woman, aged 23, unvaccinated, fell ill with symptoms of gradually increasing severity. On the day of onset she got up in the morning, but returned to bed later. On the day following she was worse, the prominent symptoms being vomiting, headache, pains in the loins and general prostration; but the symptoms were not of unusual severity. The outcrop occurred on the third day of illness. On the day following the outcrop abortion occurred, the pregnancy being of two months' date. During this time the prostration had become extreme; and on the sixth day of illness the patient was collapsed, looked bloodless, and presented a facies typical of severe forms of toxic smallpox. The mental faculties were perfectly clear. The odour of the breath was horribly fetid. Except some uterine hæmorrhage following the abortion, the first hæmorrhagic symptom which had been noticed was a bruise, which formed on the left hand after a slight blow sustained on the fifth day of illness. During the night of that day, also, there had been severe uterine hæmorrhage. On the sixth day there was extensive extravasation of blood into the fauces, the throat and palate becoming black. The lips and teeth were covered with bloody crusts, and there was conjunctival hæmorrhage in both eyes. There was a slight abrasion on the forehead, from which blood oozed. Across the loins was a band, a few inches wide, composed of numerous petechiæ lying in a dusky erythematous matrix; but that affection of the skin was confined to that situation, and did not invade the more usual situations of the toxæmic petechial rash. Some petechiæ were scattered irregularly over the chest, abdomen and legs, and mingled with them were a few somewhat larger extravasations, ranging in colour from violet to purple-black. On the arms there were several small, indistinct, vein-like, subdermal extravasations, in size from half-an-inch to one inch across. In addition, there was a large bruise on the back of the left hand and another on the right hip. The papular rash was very profuse. On the face the papules were pale

and very hard to distinguish. Elsewhere they were more conspicuous, but everywhere soft and ill-defined. A few were blood-capped. Throughout the illness no sign of vesiculation was observed in the lesions. On the evening of the sixth day there was again profuse hæmorrhage from the uterus, which continued until death. Early in the morning of the seventh day of illness the patient complained of pain over the heart, became cyanosed and pulseless, and died. She was conscious until within a few minutes of death.

Case VII.—Toxic smallpox—Scanty papular rash—Death on the seventh day of illness.—M. J. H., a girl aged 12, was vaccinated in infancy but presented only one very small cicatrix. The focal rash was first observed on the fifth day of illness, but the rash was composed only of a few papules, and there were none except on the forehead. Even at the time of death the lesions had not materially increased in number, and had not become vesicular ; but by that time a few papules could be detected on other parts of the body besides the face. The illness did not begin very suddenly. On the day of onset the child got up in the morning but, feeling unwell, had to go back to bed. She complained of headache, and of pain in the back and legs ; and there was some vomiting. On the second day of illness there were some attacks of shivering ; and during that and the succeeding days the child became progressively worse, and was delirious at night. On the third day of illness there were a few attacks of epistaxis, and some blood was vomited. On the fourth, some petechiæ were noticed about the body. A large number of these soon made their appearance ; yet they were not so distributed as to suggest a toxæmic petechial rash, but were scattered haphazard about the trunk, the shoulders, and the upper parts of the thighs. Here and there, scattered with the petechiæ, were a few small purple extravasations, in size near that of a pea. Vomiting of altered blood continued to occur at intervals, and on the sixth day blood became effused into the conjunctivæ of both eyes, and a large effusion occurred deeply in the left calf. The pulse became very rapid, and death took place early on the seventh day of illness. The delirium continued to the end.

Case VIII.—Toxic smallpox—Death on the sixth day of illness before the outcrop.—H. B., a man aged 25, unvaccinated, suffered the customary symptoms of onset and the succeeding prostration. On the fourth day of illness a petechial toxæmic rash appeared. This covered the chest and abdomen, groins and axillæ, and extended on to the shoulders and upper parts of the arms, and on to the inner and front part of the thighs. The rash extended also across the loins. The affected parts rapidly gained depth of tint and became the seats of innumerable petechiæ ; at the close of the illness that portion of the skin presented one continuous sheet of violet hæmorrhagic discoloration. A few irregular patches of discoloration developed also on the forearms, hands, and legs ; in the last situation, chiefly along the course of the internal saphenous vein. Conjunctival hæmorrhage developed in

both eyes. On the fifth day of illness the patient began to spit blood, and the fauces became intensely discoloured from extravasation into the mucous membrane. On the sixth day, a few hours before death, there was hæmaturia. No focal rash appeared, with the exception that one small vesicle was noticed on the back of the right hand.

Case IX.—Toxic smallpox in a new-born infant—Death on the second day of illness.—E. B., a female, the child of a variolous mother, displayed no abnormal symptom during the first four days of life. On the fifth day she took food badly and seemed ailing. On the following day the child was weak, and had cold extremities and pale lips. At 5 a.m. some red frothy blood was vomited. At 11.30 a.m. blood was vomited for the second time and in considerable quantity. At 1.30 p.m. the child vomited blood for the third time. She died suddenly half-an-hour later. No other hæmorrhagic symptom was observed during life, and there was no focal rash. At the autopsy, signs were observed which were characteristic of death from toxic smallpox. The child was vaccinated on the day of birth, and at the time of death displayed the first signs of a successful vaccinal reaction.

CHAPTER XII

HÆMORRHAGIC OR TOXIC SMALLPOX

So protean is the disease, and especially this graver phase of it, that but for the teaching of experience some of its manifold types might be taken for distinct disorders. But the types merge into one another. Toxic smallpox is of one kind though of many degrees; and perhaps there is more to be lost in clearness than can be gained in convenience by attempting a classification which shall lock off sections in the stream of cases. The features common to all cases, or peculiar to some, will therefore be grouped together and discussed under appropriate headings.*

Constitutional symptoms.—The description of the toxæmic symptoms, given in Chapter IX., would lack vigour if applied to these graver cases. The onset may be more

* Many authors follow Curschmann (Ziemssen's Cyclopædia) in his classification or terminology. In descriptions of smallpox it is a common practice to distinguish, under the names of "initial illness" or "prodromal stage," that part of the toxæmic fever which occupies the interval between the onset of illness and the outcrop of the focal rash. That such a distinction is arbitrary is of little moment in the description of ordinary cases. But Curschmann pursues it in the discussion of toxic smallpox, when it becomes the source of some confusion. He divides toxic cases into two groups, the first of which he calls "purpura variolosa," and defines as "the initial stage of variola which has become hæmorrhagic," and the second "variola hæmorrhagica pustulosa," under which head he includes cases in which the focal lesions become foci of hæmorrhage. Unfortunately these divisions are neither all-embracing nor mutually exclusive. And the terms themselves are liable to be misunderstood. For on account of the modern limitation in meaning of the English word "pustule," the term "variola hæmorrhagica pustulosa" is apt to be taken to refer to cases in which hæmorrhage occurs during the pustular stage of the disease; cases which, though falling strictly within Curschmann's definition, are not cases of toxic smallpox (*see* p. 75). Neither is the term "purpura variolosa" free from objection, because it is liable to be applied to cases in which a purpuric toxæmic rash is developed; and such cases, again, are not in general toxic cases.

sudden, the pains more acute; and the collapse is more profound. Yet it would be a great mistake to suppose that a fatal toxæmia is always, or even generally, ushered in very suddenly and by symptoms of unwonted severity. Perhaps in most cases one is not led at first to suspect the gravity of the illness which is about to develop; and it is not until the second or third or even fourth day of illness that the full severity of the symptoms becomes unmasked. On the other hand, it must be remembered that alarming symptoms are not necessarily the prelude to a fatal, or even to a serious, illness. It will be understood that the description of an illness of the more serious kind will fit some cases in which the issue is never in serious doubt; and at the same time will mark a standard to which some cases of toxic smallpox never attain.

Pain.—The pains, in some of these cases, are of extraordinary severity. The head may feel as though the skull were opening and shutting; the lumbar pain may be compared to a sensation as of the grinding together of the bones of the pelvis. These pains are an early developed and a persistent symptom, so that a patient may not be free of them until the natural end of the toxæmic fever, if death be delayed so long.

Prostration.—An impressive feature of these cases, though one shared by all cases marked by a severe toxæmia, is the excessive prostration of the patient. The prostration develops with a rapidity corresponding to the more or less sudden onset of the illness, but is not at its height until the lapse of the first two or three days. It is then marked by a loss of tone of the whole muscular system.

On the face this symptom impresses a very characteristic appearance which, once observed, is not difficult to recognise. (Plates LXXXVI. and LXXXVII.) The relaxation of the muscles of expression makes the patient look dull and apathetic. The features are immobile, the lines of expression obliterated, the cheeks relaxed. The lips are full and parted, dry, with sordes on them, or perhaps encrusted with dry clouts of blood. The skin may be flushed or pale. The eyelids droop,

and it seems to be an effort to lift them ; yet, when the lids are raised, the eyes look bright and shining. (Plate LXXXVIII. and LXXXIX., Fig. 1.) The ocular muscles share in the symptoms, and the patient is apt to follow a moving object by a movement of the head rather than of the eyes. When he is addressed, it is seen that his faculties are clear; but he rouses himself with an effort, answers with deliberation, and relapses into apathy. Except that he breathes easily, he looks like a man who has just undergone a great and sustained physical exertion; like a runner after the race, self-centred, absorbed in the attempt to renew his exhausted powers.

With a prostration so profound, it is not surprising that the course of the illness may be interrupted by attacks of collapse, during which the patient displays a clammy skin, cold extremities, a feeble pulse, and perhaps some cyanosis. Such a condition is liable to be brought about by some effort, little enough in itself, perhaps, but disproportionate to his enfeebled powers. Even the less serious forms of toxæmic fever are not infrequently marked by symptoms of collapse when the patient has overtaxed his capacity for exertion. Sometimes the heart-failure is still more profound, and is signalised by cardiac pain and a fluttering pulse. From such an attack of syncope the patient may rally, or it may prove rapidly fatal.

In exceptional cases the aspect which has been described is concealed by the anxiety and distress caused by the intensity of the poisoning. (Plate LXXXVIII.) The stimulus of an excessive dose may, indeed, be such as to mask all the prostration on which that aspect depends: and the patient may exhibit a deceptive capacity for exertion, until he collapses upon the brink of death.

Mental symptoms.—The usual mental symptoms are persistent sleeplessness and an unnatural clearness of the intellect, so that the patient shall miss nothing of his sufferings. In some cases the mind becomes clouded, or there is delirium; but generally only towards the close. Yet, with children, nocturnal delirium is common earlier in the illness.

Pyrexia.—From case to case the curve of temperature

presents considerable variation. In some cases, and those generally the worst, a low temperature prevails, and the thermometer may never record 100°. In other cases, especially those in which life is most prolonged, a high temperature is the rule. (Charts IX. and X.) This inverse proportion between the height of the temperature and the severity of the

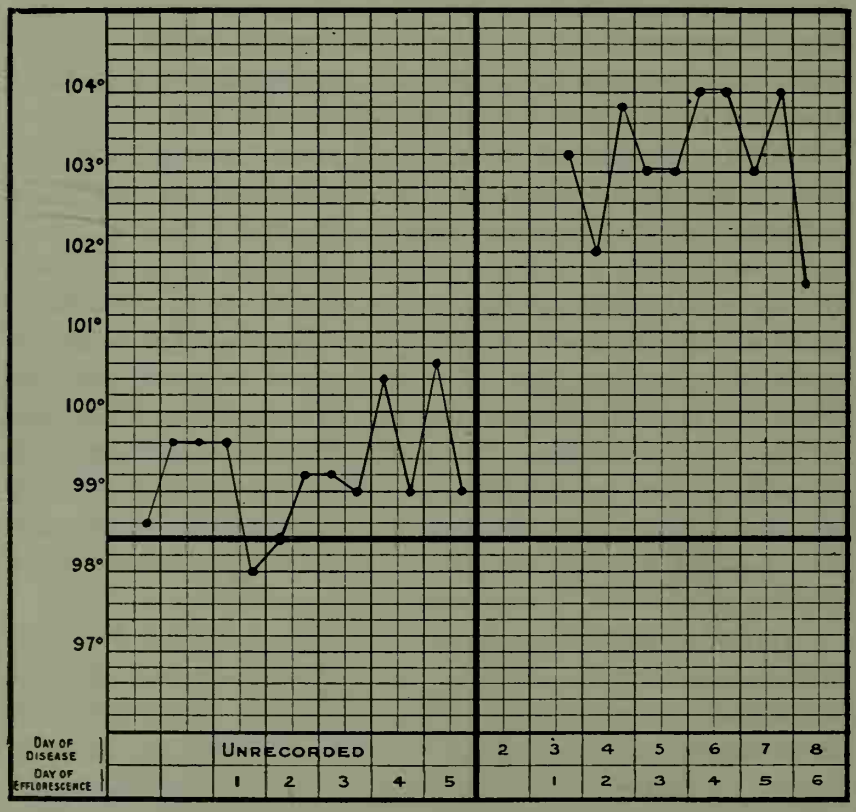

Chart IX.—Toxic Smallpox. Temperature Low.

Chart X.—Toxic Smallpox. Temperature High.

attack is common both to toxic smallpox and to toxic scarlet fever, though with toxic scarlet fever the low temperature is very much less common. With smallpox, besides, discrepancies are common in similar cases, so that the thermometer is not of much use in forecasting the probable course of the illness. Even when the fever runs high, the end may be

preceded by a fall of temperature. On the other hand there may be terminal hyperpyrexia. (Charts XI. and XII.)

When the illness is protracted, it may happen that the

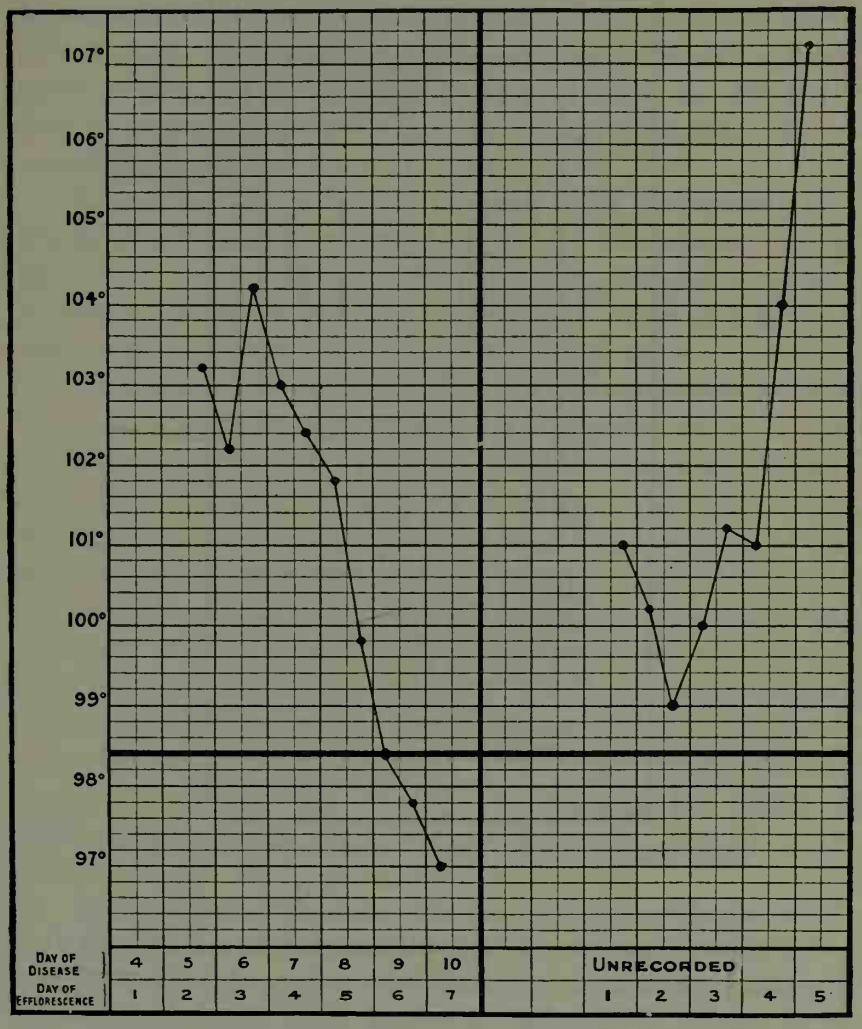

CHART XI.—TOXIC SMALLPOX. LOW TERMINAL TEMPERATURE.

CHART XII.—TOXIC SMALLPOX. HIGH TERMINAL TEMPERATURE.

patient will survive the onset of the eruptive fever. In such a case, as in most cases of confluent smallpox, the distinction between the two febrile states may be indicated on the chart by a dip in the curve of temperature. (Chart XIII.) But

frequently this break in the curve is obliterated, either by the febrile effect of some complication, or else by the blending of the two fevers.

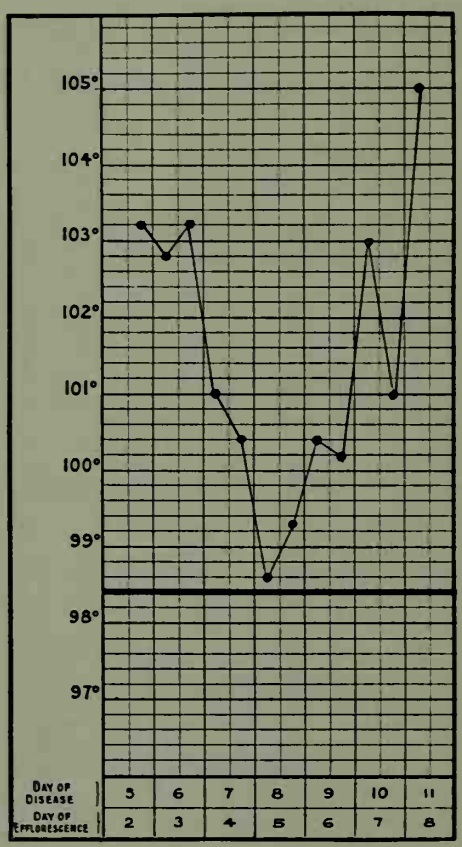

Chart xiii.—Toxic Smallpox. Toxæmic Pyrexia Distinct from Suppurative.

Fœtor.—There are a few other symptoms of which it is necessary to take account. The most easily observed is a fetid odour of the breath. This sign is very commonly, though not invariably, met with in toxic cases; on the other hand it is occasionally to be observed in cases which hardly attain to the toxic standard. The symptom will not be confused with the foul odour encountered in certain cases of confluent smallpox, which is merely an emanation from the suppurating skin. And the fœtor, probably, does not arise

from the foul condition of the throat which occurs in some cases of toxic smallpox owing to extravasation of blood into the mucous membrane; for the fœtor may be observed in cases in which the throat is unaffected. The odour seems to be an exhalation from the lungs, arising from certain changes in the blood. It is a sickly odour, unique in the catalogue of nasty smells, and a breath of it, once inhaled, will dwell for ever in the recollection. The sign is often the first danger signal displayed in the course of the illness.

Albuminuria.—Albuminuria may occur as an early and transient symptom of more than one of the specific fevers, and it is met with very frequently in cases of confluent smallpox. In toxic cases it is especially common and conspicuous, even when unassociated with hæmaturia.

Enlargement of the liver.—A less constant symptom than the last is a rapid and painless enlargement of the liver. Like albuminuria, this symptom is liable to attend, not only the toxic, but also all the severer forms of smallpox. The enlargement becomes perceptible towards the end of the toxæmic fever, and continues its progress during the first part of the fever of suppuration. But in toxic cases the symptom may be apparent earlier in the illness and become very pronounced. Therefore, when other signs are indistinctive, some importance attaches to the perception of the liver's edge, one or two fingers' breadth below the cartilages, moving downwards from day to day. Sometimes the spleen is enlarged and perceptible to the touch, but far less frequently than the liver.

Termination.—Patients who die of hæmorrhagic smallpox do not die of hæmorrhage. The prostration which they suffer is evidence of a disturbance of the heart which is often so profound as to be fatal. Those who are killed by the toxæmia die, almost invariably, either from heart-failure, or from a common and fateful complication, œdema of the lungs.

Œdema of the lungs takes time to develop and to kill. Heart-failure, therefore, is the cause of death when the disease kills quickly. The end may be sudden from syn-

cope; or its approach may be more gradual, and marked by a failing pulse, increasing pallor, and cyanosis. (Cases VI. and VII., Chapter XI.)

In the more protracted cases heart-failure may be still the cause of death. But more often the lungs become engorged and sodden, and the patient is likely to expectorate quantities of clear or blood-stained fluid and to die water-logged, drowned in his own secretion. Even though the patient survive this condition, it may be only to die of pneumonia. (Cases II., III. and V., Chapter XI.)

Recovery.—The frequency of recovery from toxic smallpox will depend upon the definition of the term. If the condition is defined by reference, not only to the hæmorrhagic, but also to the other symptoms, cases of recovery are very exceptional. A patient, for instance, may develop hæmaturia together with certain other less important symptoms of hæmorrhage; yet he may suffer so little prostration that the issue will be hardly in serious doubt. Such cases are met with occasionally, and it would be a misuse of terms to instance them as cases of recovery from toxic or hæmorrhagic smallpox.

Though recovery is so exceptional when the patient exhibits, not only pronounced hæmorrhagic symptoms, but also excessive prostration, the characteristic facies, or the fœtor oris, yet as a matter of fact such patients often survive the toxæmia. And the termination of that stage of the illness is sometimes very well defined. The pains disappear, if they have lasted so long, the symptoms of collapse pass off, and the patient loses the facies and the sense of prostration which the collapse provoked. But these omens are generally illusory. Death, probably, will soon be brought about by œdema of the lungs, which the toxæmia has already engendered, or by pneumonia arising out of it. If the patient escape those dangers, the focal rash will be likely to prove fatal. In most of these cases the rash is profuse and is sufficient to kill, in the earliest stage of its suppuration, a patient already worn out by the previous illness. Sometimes, however, the patient does not succumb until late

in the secondary fever, and occasionally recovers completely.

Complete recovery from toxic smallpox is generally attributable to the fact that the rash is of moderate severity only, or is partly modified. It has been pointed out (Chapter IX., p. 63) that a severe toxæmia is not necessarily the prelude to an abundant focal rash; and that a total loss of immunity to the toxæmia may co-exist with the retention of some immunity to the eruptive fever. It follows that, though with toxic smallpox it is the rule for the rash to be excessive if the patient lives long enough for it to develop, yet in some cases the rash will not be very abundant, and in others will display some degree of modification. (Plate LXXXV., Fig. 1.) It is usually in such circumstances that recovery from toxic smallpox occurs.

Duration and course.—In exceptional cases, which there is no hesitation to class as toxic, life is prolonged far into the secondary fever. But as a rule the patient does not survive beyond the eighth day of efflorescence; a date which would correspond, in most cases, with the tenth or eleventh day of illness.

With natural smallpox the onset of suppuration occurs on the fifth day of efflorescence, and by the eighth the eruption has completely matured. With toxic smallpox, also, the course of events in that respect may be not materially different; that is to say, a patient, dying on the eighth day of efflorescence, may display a pustular eruption. (Cases II. and III., Chapter XI., and Chart XIII., p. 90.) But in many other instances life may be prolonged to the same extent, and yet suppuration may hardly become evident.

Such delay in the advent of suppuration is occasioned by the undue severity and duration of the toxæmic fever. In most cases of toxic smallpox the outcrop occurs at the usual time, that is to say, on the third or fourth day of illness. Yet, as was pointed out in Chapter VI. (p. 42), an excessively severe toxæmia is capable of retarding all stages of the subsequent evolution of the eruption. (Cases V. and VI., Chapter XI., and Chart XI., p. 89.)

The toxæmic fever may be prolonged, also, by a protracted interval between the onset of the illness and the outcrop of the rash (*see* Chapter IX., p. 62). The outcrop may be postponed until after the fourth, or fifth, or even the sixth day of illness. A delayed outcrop is a feature of some of the worst cases. (Case VII., Chapter XI.)

On account of this variety in the possible course of the illness, there is no uniformity of clinical aspect about patients who have been ill for the same length of time. Patients even, whose eruptions are of the same age may display considerable variety in the character of the rash.

The worst forms of an illness are generally the least common, and cases of toxic smallpox occur with a frequency which is in inverse proportion to the rapidity of the fatal issue. Most cases are fatal after the seventh day of illness; and in such, whatever its precise character may be, a pronounced eruption is almost always developed before the end of the illness.

When the date of death falls between the fifth and seventh day of illness, there is much more inconstancy as to the prominence which the eruption attains. A well-developed vesicular rash may be seen in a case fatal on the fifth day, and but a few scanty papules in a case fatal on the seventh.

Patients sometimes die before the outcrop. In such cases, for the reasons already set forth, it by no means follows that the illness is of the briefest. (Case VIII., Chapter XI.) In the majority of instances the patient does not die before the fourth day. Indeed, death earlier than the fourth day is altogether exceptional; yet it is possible for the toxæmia to kill in little more than twenty-four hours.

CHAPTER XIII

HÆMORRHAGIC OR TOXIC SMALLPOX (concluded)

The focal rash.—The clinical character of a case depends chiefly upon the prominence attained by the focal rash. If the eruption is absent or inconspicuous, the case is dominated by the constitutional and hæmorrhagic symptoms; but in most cases, however the illness commenced, the skin affection ultimately usurps the attention, and the disease seems to be almost as much a dermatosis as a constitutional disorder.

The kind of rash met with in the commonest sort of case has already been described in Chapter VI. (p. 40). The rash is profuse; on the face it is confluent or superconfluent. In its earlier stage it is generally bright red; occasionally the colour tends to a dusky tint; it is pale only when the prostration is extreme. The papules are soft, and often inconspicuous individually. The vesicles are flat, flaccid, and sluggish in evolution. (Plate LXXXIX.) In some cases the cuticle becomes detached, here and there, and blebs are formed containing blood-stained serum.

The capacity of the lesion to provoke effusion of blood increases with its progress in evolution. Many cases in which the rash becomes vesicular are, therefore, distinguished by pronounced hæmorrhagic extravasations about the lesions. (Plate XC.) Yet it must be remembered that the prominence which this symptom attains is governed very much by individual idiosyncrasy. In many cases of confluent smallpox, approximating to the malignant type but sustaining no claim to be called toxic, the lesions exhibit, here and there, more especially on the limbs, purplish subvesicular staining or violet-tinted areolæ. And there are cases of toxic smallpox in plenty, with well-developed focal rashes, which display hæmorrhagic extravasations of no greater prominence.

When death occurs before the rash has passed beyond the papular stage, even though the papules may have been developed in abundance, hæmorrhage about them is generally absent or inconspicuous. Yet of some such cases these extravasations form a prominent feature. (Plate XCI.)

When the patient dies before the efflorescence is completed the rash is likely to be still more anomalous than in the cases already considered. The papules are soft, pale, and almost flush with the surface of the skin. If hardly perceptible to the eye, they are still less obvious to the touch. And what makes the case still more puzzling is that the suppression of the development of papules is apt to be more complete on the face than elsewhere, because the face, being naturally best supplied with blood, suffers most from the depression of the circulation. Under these circumstances, when the observer is confronted with an eruption, anomalous both in the character of its lesions and in their apparent distribution, it is not surprising that the nature of the case is easy to mistake. Cases in which death wholly anticipates the efflorescence are, in reality, very exceptional. More often, when cases of that repute occur, it is possible to detect a few papules if they are sought, not on the face, but on some part of the body where the circulation is less impaired.

The symptoms of hæmorrhage.—Even when these symptoms are pronounced, no patient runs up the whole gamut of expression of the hæmorrhagic tendency. There are, therefore, many possible combinations of the symptoms and corresponding variety in the aspect of the case. Such differences are determined by no sort of rule. Whether death comes early or late, whether the focal rash is well or ill developed, the food or air-passages, the lungs, the kidneys, or the cutaneous surface may be the seat of the dominating hæmorrhagic symptom, or any combination may fall to be endured.

It must not be assumed that the nature of the attack is always advertised boldly in symbols of blood. Even if the hæmorrhagic symptoms do ultimately become conspicuous,

in most cases they are not of very early development. In the action of the toxin on the blood-vessels, time seems to be an element of importance; and, as a rule, the hæmorrhagic symptoms do not appear until late in the illness, and perhaps not until near its close.

In a minority of cases the symptoms of hæmorrhage never become very prominent. Most of such cases are near the borderland of the class. Yet these symptoms are not necessarily pronounced when the attack is of the first severity. New-born babies are especially susceptible to the operation of the toxin, and occasionally die of toxic smallpox with the hæmorrhagic symptoms wholly suppressed.

A child, 10 days after birth, developed a very scanty variolous rash, the papules being very soft and inconspicuous even at the time of death, which occurred four days later. Death was sudden. No hæmorrhage was observed during life, but at the autopsy a few trivial internal extravasations were found.

Such cases suggest that, in excessive doses or in highly susceptible subjects, the toxin may sometimes paralyse the heart before it can injure the vessels.

Toxic rashes.—Petechiæ and such small cutaneous extravasations are exceptional in often making their appearance earlier in the illness than most other hæmorrhagic signs. That circumstance is of service to the observer when the petechiæ are components of a purpuric rash.

The purpuric rash.—The purpuric rash, described in Chapter X., is seen in a considerable proportion of toxic cases. But it is sometimes so vivid and extensive, and the tendency to blood-staining is so much exaggerated, that its identity is apt to be obscured and its real nature to escape recognition. In such cases the surface affected is packed densely with small petechiæ and pricked out with larger shot-like extravasations; while the erythematous matrix in which these are embedded may appear as a broad sheet of dark-red or violet discoloration. (Case VIII., Chapter XI.) Sometimes the change goes further, and the surface is splashed with irregular patches of purple in which the finer markings are

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lost. First seen thus, the best part of the skin of the trunk all claret-stained, it may never suggest itself that the rash is generically the same as the familiar stippled erythema limited to the region about the groins.

There is another reason which, in toxic cases, is apt to make this rash more difficult of recognition. It has been mentioned that in some cases the erythematous basis of the purpuric rash encroaches beyond its normal limits. (Chapter X., p. 68.) This is most likely to happen when the patient has toxic smallpox; the back and limbs may be then extensively invaded by the erythema, and even the whole body covered. But whereas, ordinarily, such an overflowing of the erythema is likely to be fugitive and not to obscure the characteristic distribution of the rash, in toxic cases there is the difficulty that any kind of erythema is liable to take on a special character and to exhibit blood-stasis and some degree of blood-staining. Nevertheless, even under such confusing circumstances the identity of the rash is seldom lost, because of the special aggregation of purpuric elements in its peculiar area of choice. This exact identification of the purpuric rash is of no little importance, because in some cases of toxic smallpox the diagnosis turns upon its recognition.

Though in many instances the rash presents the striking effects which have been described, it must be remembered that even in toxic cases it more commonly displays the usual characters of tint and distribution described in Chapter X. H. 67-70

It is risky to found a prognosis on the character of the rash. Its association with extensive diffuse violet or purple discoloration is generally portentous. Yet an unusually vivid and deeply-stained rash is sometimes the occasion of a mis-diagnosis of hæmorrhagic smallpox in the case of a patient who makes a good recovery and, perhaps, never develops more than an abortive focal eruption and a trifling secondary fever.

Toxic erythema.—In some cases of toxic smallpox another kind of rash is encountered which, unlike the purpuric rash, is devoid of any striking peculiarity of character or distribution. It occurs as a patchy or uniform erythema, sometimes

limited to the trunk, sometimes extending to the limbs or to the whole body. In many cases the erythema, like the erythema of the purpuric rash, becomes the seat of diffuse or blotchy blood-stains, especially when it persists until near the fatal termination; or, again, its uniformity may be relieved by petechiæ. But the display of hæmorrhage is an accidental, not an essential attribute. In character, the rash may resemble closely some of those benign toxæmic erythemata which are most prone to affect the trunk of the body. (*See* Chapter X., p. 70.) The points of distinction are that the toxic erythema is less fugitive, is of deeper tint, is liable to exhibit blood-stasis or blood-staining, and is apt to produce a leather-like stiffening or thickening of the skin which it occupies, so that the rash can be felt as well as seen. But, in fact, the two kinds of rash are little likely to be confused, because they are encountered in cases of so different a character.

There is more risk of the toxic erythema being attributed to another exanthem. The interrupted character which it frequently displays may be the occasion of confusion with measles, as is often the case with the rose rashes described in Chapter X.[179] The severity of the constitutional symptoms, the insignificance of any symptoms of catarrh which may be present, and the absence of pulmonary symptoms are a combination which forms an important distinguishing feature. Though œdema of the lungs is common with toxic smallpox, this complication is not of early onset, and its advent would be accompanied by other less ambiguous signs. The development of symptoms of hæmorrhage, though not absolutely precluding a diagnosis of measles, should suggest an attitude of extreme caution.

A diagnosis of scarlet fever may be suggested either by the toxic erythema or by the petechial rash. The mistake is not very frequent, and there may be no facts to justify it except the presence of the rash itself. Nevertheless the condition of the throat may give colour to the mis-diagnosis. A not infrequent symptom of toxic smallpox is a deep congestion of the fauces, palate and root of the tongue, which gives place

quickly to a bloody extravasation into those tissues. (Chapter XI., p. 79.) There is, however, no ulceration of the throat, no exudation, no enlargement of the tonsils, no swelling of the lymphatic glands or of the cellular tissue below the jaw. Though the temperature may be high with toxic smallpox, not infrequently it is low; whereas with scarlet fever the fever is high except with intensely malignant cases. And vomiting, which is an extremely frequent and prominent symptom of scarlet fever, is generally not very pronounced, and is often absent even in the worst cases of smallpox.

Post-mortem signs.—The results of the autopsy will correspond with the signs of hæmorrhage observed before death; extravasations of blood along the urinary tract will be found when there has been hæmaturia, congested lungs when there has been hæmoptysis, gastric or intestinal extravasations when there has been bleeding from the stomach or bowel. Certain internal extravasations produce no symptoms, and in their enumeration it will be presumed that only some of them will be detected in a particular case.

Lungs and air-passages.—The structures along the respiratory tract are liable to considerable damage. The pharynx, tonsils, palate, the root of the tongue and the epiglottis may be stained black by the effusion of blood. The larynx and trachea, also, are often deeply stained. In many instances the lungs are deeply congested throughout; but sometimes the congestion is limited to their bases. In certain cases distinct extravasations are found scattered about the lung tissue, and sometimes wedge-shaped pulmonary "apoplexies" may be seen on the surface. In most cases the tissue is not only congested but also œdematous; yet, as a rule, there is no pneumonic consolidation. Pleuritic effusion is uncommon and always slight; but recent pleural adhesions are met with with some frequency.

Alimentary tract.—The intestinal canal is much less frequently affected. Violet petechiæ and larger purple extravasations may be found scattered about the mucous membrane of the stomach and small intestine. Occasionally the whole circumference of the gut for a few inches is black from extensive extravasation beneath the mucous membrane.

Urinary organs.—Hæmaturia is associated with extravasations in the kidney or, less frequently, in the bladder. In the bladder these appear as black plaques upon the internal surface. In the kidney the extravasation takes place beneath the lining of the pelvis. Small

extravasations are met with sometimes on the surface of the kidney beneath the capsule. Less commonly the whole organ is enlarged and congested.

Liver and spleen.—The condition of the liver is singularly variable. It is a remarkable fact that an illness of about a week in duration should be capable of increasing so greatly the weight of the organ. In the absence of any morbid change except those found after smallpox, the weight attained may be anything up to 6 lbs. But in most cases the weight does not exceed 4½ lbs., and not infrequently it is within the normal limits. In some cases the organ is much congested and, when cut, drips with blood; in other cases the tissue is pale. The liver exhibits sometimes an early stage of "nutmeg" degeneration. In many cases the tissue is unnaturally yellow in colour. This colour is probably due, in most instances, to altered blood-pigment; for, though fatty degeneration is found occasionally, such a change is not very common. Indeed, the tissue is so far from being soft, that in most cases an unusual toughness is its main characteristic.

As often as not the spleen is within the normal limits of size; and when it is enlarged the weight seldom exceeds 12 ozs. The colour and consistency are very variable.

Serous surfaces and connective tissue.—The serous surfaces nearly always exhibit a certain number of petechiæ and small circular extravasations, but these are seldom very abundant. They occur in the pleura, in the pericardium (chiefly in the visceral layer near the base of the heart), and in the peritoneum. In the last situation the favourite places are along the gut and in the mesentery.

Extravasations often occur in the areolar tissue in various situations. Such effusions are most apt to come in the tissue about the kidneys and along the attachment of the mesentery, and in those situations are not infrequently rather extensive; but smaller extravasations are liable to be found almost anywhere, from the intermuscular spaces to the fissures of the brain.

Vascular system.—The condition of the blood should be noticed. In the great vessels the blood is generally uncoagulated, and in some cases it may be fluid even in the heart. More often, there is some clotting in those cavities, more especially on the right side. The clot may be red, and is often soft and friable; but in some cases a firm white clot is found.

Diagnosis.—In this domain, so obscure and intricate and so difficult of survey, it is impossible to show an easy path among the pitfalls and the thickets. But there are a few useful landmarks to be recognised.

Fortunately, in most cases it is not very difficult at least to identify the disease. Most patients survive until the focal rash has become a pronounced feature of the case; and since

the outcrop of this rash commonly occurs at the usual time, and the rash has the usual distribution, the correct diagnosis will be suggested by that distribution, even though the lesions be anomalous in character. Yet, since hæmorrhage may be a late or a terminal sign, the character of the illness may not at first be easy of recognition, even when the disease itself can be identified. It is, in fact, not an uncommon experience that the gravity of the illness is not realised until near its termination. An earlier recognition will depend, often, upon the appreciation of symptoms less obvious than those of hæmorrhage; the vivid tint of the rash, the softness of the lesions, their tardy efflorescence and evolution, the deepening collapse and the presence of some of those other signs which were mentioned early in the last chapter.

The difficulties are most formidable in the minority of cases when the rash is late in outcrop, unusually deliberate in evolution, and atypical not only in character but also, at first at all events, in distribution. The onset of hæmorrhage and its association with a papular or vesicular eruption will, in many cases, ultimately suggest smallpox. But before hæmorrhage occurs it may be easy to mistake the whole nature of the disease. Indeed, in some cases the presence of the specific lesions may be altogether overlooked.

In all these cases, and particularly in those in which the outcrop is long delayed and perhaps anticipated by death, a sign of inestimable value, if it is present and can be seized, is the purpuric rash. It comes early in the illness, and its frequency of occurrence increases with the severity of attack. It is, therefore, most frequent in the cases of which the difficulties of diagnosis are most profound. It is often stated that this rash is limited in its distribution to the groins and hypogastrium, the so-called "genito-crural triangle." Those who look always for such a limitation of the rash will often miss it. But if it be remembered that it may have the wider distribution which is often seen in these graver cases, and if the vagaries of its character be allowed for, it will become of twice the value.

Another sign which is, perhaps, still more common, and

for which the observer should not fail to seek, is enlargement of the liver. This, when present, is easy of detection. When the enlargement is considerable, the edge of the liver may be found as near the umbilicus as the ribs. But the value of the sign is less conspicuous than that of the sign last discussed. The symptom does not appeal to the eye, and is therefore the easier to miss. It becomes prominent later in the case. It is not pathognomonic of smallpox and, unless the growth be watched, it cannot confidently be ascribed to the current illness. Nevertheless, the symptom may afford very valuable confirmatory evidence in a case of doubt, especially in the cases of children and young adults.

When the purpuric rash is absent and death takes place before the outcrop, the diagnosis must rest heavily upon the hæmorrhagic symptoms. In these cases, happily not numerous, such diseases suggest themselves, according to the character of the hæmorrhage, as diphtheria, acute nephritis, blood-poisoning. Diphtheria, like scarlet fever, is apt to be suspected when there is extravasation into the mucous membrane of the fauces, and diphtheria is well known to be associated sometimes with hæmorrhagic symptoms. But with toxic smallpox there is never any formation of membrane. "Blood-poisoning" is the commonest mis-diagnosis in these obscure cases, and many an outbreak of smallpox has been traced back to a case so labelled. So inexact a diagnosis may be regarded as little more than a confession of ignorance of the nature of the illness, the fact being that smallpox was never thought of. Occasionally a case of enteric fever, of ulcerative endocarditis, or of some other disease is certified as toxic smallpox on the strength only of certain signs of hæmorrhage. In such instances a knowledge, not so much of the hæmorrhagic, as of the associated symptoms of toxic smallpox, would go far to shake the erroneous conclusion.

CHAPTER XIV

ERYTHEMATA: SIMPLE AND SYMPTOMATIC

Measles.—More than a thousand years ago the difference between smallpox and measles was recognised by Rhazes, the Persian. Smallpox, he said, is ushered in by pain in the back, and its papules are round and prominent; whereas the papules of measles are nearly level with the surface of the skin. With the latter disease, doubtless, he grouped scarlet fever and other acute fevers distinguished by an extensive symmetrical erythematous eruption; and since in his writings he constantly coupled the two names, it may be questioned whether he looked upon smallpox and measles as more than different forms of the same malady. However that may be, no adequate distinction was made in later ages, and it was not until the time of Sydenham that smallpox, measles and scarlet fever were clearly recognised as separate diseases breeding true.

Confusion between things so distinct is less surprising when it is remembered how vague was the pathology of those times. A disease was the expression of a morbid tendency, or state of the blood, which showed itself in this way or in that according to the idiosyncrasy of the individual, his mode of life, or so forth. In the days when infectious disease ran riot, and a pestilence was supposed to be as much in the order of nature as an earthquake or a flood, accurate observations as to the generation of these fevers were not easy to make. Smallpox, like measles and scarlet fever, was then a disease of childhood. And if he began with the assumption that it depended upon the patient's complexion, or upon the state of the weather, for an erythematous or papular eruption to give place, or not to give place, to vesicles and pustules, a man might live a lifetime and not find out the difference.

He might, like Rhazes, detect a difference between the soft flat rash of measles and the raised papules of smallpox; yet when he observed other cases in which a toxæmic rash, to all appearance like the rash of measles or of scarlet fever, was followed by a pustular eruption, how could he but conclude that the difference was unessential? Even the distinction which Rhazes drew does not always hold good. There is many a rash of measles and many a papular variolous rash which few of us could tell apart. It is such rashes which now fall to be considered.

When measles is mistaken for smallpox, the patient, very generally, is an adult. Measles in adult life is not very uncommon, and the illness is not insignificant. That many more adults do not suffer is due only to the fact that most have acquired immunity by a previous attack.

The symptoms of invasion of the two diseases are very similar. With each an interval of a few days elapses between the onset of illness and the outcrop of the rash. In selected cases, no doubt, the constitutional symptoms of one disease and the other may show considerable divergence; but even pain in the back is not wholly characteristic, and there is hardly a combination of symptoms possible to one disease which may not be found occasionally with the other. Catarrhal symptoms are the most distinctive feature of measles, and if these should be very pronounced they would afford good evidence in its favour. Yet, otherwise, such symptoms would not be of the first value; for with smallpox the eyes are suffused and there may be lacrymation (Plate xciv.), sometimes the conjunctiva is slightly injected, and there may be even a complaint of sore throat. The presence of Koplik's sign would be of importance, but not its absence; for by the time the rash has become evident the sign may have disappeared. It should be remembered that the lesions of smallpox are very early to develop on the mucous membrane of the mouth, and may be found sometimes in that situation before the papules have appeared on the skin. Upon the mucous membrane the lesion comes as a small red soft spot which soon becomes grey. There might be some risk of con-

fusing Koplik's spots with these variolous lesions but for the fact that the latter have a different distribution, being found chiefly on the palate and fauces and but to a slight extent, if at all, at the side of the mouth.

A more telling point of difference may lie, not so much in the character, as in the intensity of the symptoms of onset. For a patient with measles to present a profuse eruption, he need not be very ill nor have an attack of more than average severity. (Plate XCII.) But for a similar rash to be caused by smallpox, the patient must have a confluent papular eruption and an exceptionally severe illness. If measles be really the disease, this disparity between the character of the symptoms and the character of the rash may furnish significant evidence against the other. Patients with confluent papular smallpox, or those who have an exceptionally severe toxæmic fever, are, in fact, just those who are apt to exhibit an eruption of which the elements approach closely in character to those of measles. The prostration attending the illness so alters the character of the rash that the papules fail to convey that sense of definition and resistance on which the recognition of them so much depends. (Chapter VI., p. 40.) The papule, in such a case, becomes something like the papule of measles, which is soft, lacks prominence, and merges imperceptibly into the areola which surrounds it. (Plate XCIII.) The similarity is most noticeable on the exposed parts, the face, hands and wrists. On the face the rash of measles may pass itself off very well for a confluent papular variolous rash of such close texture that the individual elements are indistinguishable. About the wrists the rash is less likely to be confluent, but in that situation the papules are apt to be exceptionally prominent and well defined, and not far removed in character from the papules of smallpox. Under such circumstances a hasty inspection of the case is very likely to convey a wrong impression; but an examination of other parts of the skin generally reveals elements of too discordant a character and of too indifferent a distribution to be consistent with such a diagnosis.

The real trouble comes earlier, when the rash is only partly developed. On p. 33 it was pointed out that a papular variolous eruption, sufficiently early in efflorescence, has an incomplete distribution and is limited to the face and upper part of the body. That circumstance must be remembered in differentiating any papular eruption of similar arrangement. The fact is of particular importance in the case of measles, whose rash, like that of smallpox, begins at the top and spreads downwards. In such a stage of events the character of the lesions of the two diseases may be indistinguishable; for variolous papules of only a few hours' growth may be quite as soft and inconspicuous as those of measles of a similar age. Though the identity of arrangement may be almost as complete, the distribution may nevertheless be the most reliable guide. The rash of measles is wont to explore the parts round the ears, on the forehead, and among the hair-roots, and to display indifference to the flexures of the body and to the bays and promontories of the cutaneous surface. (Plates XXXIII., Fig. 2, XCIV., and XCV.) Fortunately the resemblance is fleeting, and a few hours will change the whole aspect of the rash.

There seems to be no tendency to confuse the papular variolous eruption with measles, the mistake being almost always in the other direction. Yet a very large number of cases of smallpox are at first mistaken for measles, for with the majority of patients who exhibit a toxæmic rose rash measles is the preliminary diagnosis. The points of distinction were enumerated in Chapter X (p. 71.). The misconception would nearly always be avoided if it were remembered that an erythematous eruption is probably not due to measles unless it is associated with distinct symptoms of catarrh. It cannot be said that the mistake is an important one, as it tends to be so speedily corrected. The error is more serious, though less frequent, when the patient has toxic smallpox with a diffuse erythematous toxic rash. The death may then be certified to be from measles, the real fact being disclosed only by the lamentable occurrence of secondary cases. To the remarks made in the last chapter

(p. 99), it may be added that measles with hæmorrhage is very rarely encountered except with young or weakly children.

Other infectious exanthems.—*Scarlet fever—Rubella.*—The toxæmic rashes of smallpox, which so often suggest measles, occasionally suggest scarlet fever, but the latter misapprehension is incomparably the less frequent (pp. 69 and 72). A similar mis-diagnosis may be caused by the rashes of toxic smallpox (p. 99).

Unlike that of measles, the eruption of scarlet fever cannot very well be confused with the papular variolous rash. But the scarlatinal rash is capable of being mistaken for a toxæmic eruption, though such an accident should be prevented by an examination of the tongue and throat and glands. Rubella, also, may occasion a similar mistake. Such a misunderstanding in the case of either disease is exceptional, and comes about by the association of one of them with an outbreak of smallpox. Smallpox never causes enlargement of the glands early in the illness, and the condition of the tongue produced by it has none of the scarlatinal characteristics.

Enteric fever.—Enteric spots have been mistaken for variolous papules when the disease has been latent, and the rash unusually plentiful. The enteric rash is somewhat more deceptive when some of the lesions, as may be the case, show a tendency to become vesicular. An immature papular variolous eruption, on the other hand, has sometimes led to a diagnosis of enteric fever. Both accidents are exceptional. Rose spots are softer and less prominent than the papules of smallpox, and are differently arranged. Their choice is for the trunk, and for the chest and abdomen rather than the back. It is not uncommon for the spots to be found upon the thighs; but the arms and legs, and above all the face, have little liability to be affected.

With some cases of enteric fever it is well known that, besides or instead of the usual exanthem, purpuric spots are developed in the skin. These may be like flea-bites, or may be larger and rather darker in tint. In such cases the attack

is not necessarily of more than average severity. These hæmorrhagic extravasations occasionally suggest a diagnosis of toxic smallpox. Against that view would be the absence of severe pain, of severe constitutional disturbance, and of serious prostration; the facies would be different from that of toxic smallpox; an enlarged spleen would not count for much, but there would be no enlargement of the liver; and, almost certainly, there would be no other hæmorrhagic symptom, and no erythematous rash.

Typhus.—If this were a commoner disease, or if an outbreak of it were associated with an epidemic of smallpox, the two things might be more often confused. Occasionally toxic smallpox is certified as typhus, but this result arises from deficient experience and not from a real resemblance between typhus and toxic smallpox; the patient has fever and exhibits hæmorrhagic extravasations into the skin, and typhus is known to be a disease with which this association is constant. The fact is, when typhus, as often happens, fails to be recognised, toxic smallpox has no tendency to suggest itself as a possible diagnosis. On its first appearance the rash of typhus does not suggest hæmorrhage. It is an erythema, like the rash of measles; the papules are pink or red, and though the colour may from the first be difficult to discharge by pressure, it is not until later that the spots become distinctly hæmorrhagic. The temptation with typhus is to mistake the rash for that of one of the commoner exanthems—scarlet fever, or enteric fever, or measles; and in the rare cases in which smallpox is suspected, it is the papules of discrete or confluent smallpox for which the lesions are mistaken. For the misconception to arise, the papules, like those of measles under similar circumstances, must be unduly firm and prominent. But the distinction is very much easier than with measles, because the distribution of the eruption of typhus does not resemble that of a variolous rash at any time of its development; it does not begin on the face, and in many cases never appears there; on the contrary, it is apt to appear early and to be pronounced upon the abdomen and neighbouring parts.

Simple or unspecific erythemata.—*Simple purpura.*—If the purpura of typhus can be suggestive of smallpox, it is not surprising that the mistake should be more frequent with simple purpura, a disorder so much more frequently encountered. In such cases the lesions appear first as pink, slightly elevated, erythematous macules, and it is when they are in that state that they are deceptive. The illness is sometimes attended by slight fever and by some pain in the limbs, a circumstance which adds force to the suggestion of an exanthem. The resemblance does not persist, because the colour of the spots rapidly deepens and becomes fixed, even if it is not imperfectly mobile from the first. The spots, although they may be unduly prominent and form definite papules, lack altogether the peculiar firmness of variolous papules.

Erythema rheumaticum.—This malady, like simple purpura, resembles smallpox only in exceptional cases, the lesions being generally of too divergent a character to be mistaken. Yet the confusion arises less infrequently with this disorder than with the other, for the reason that the papules are more apt to be firm and prominent and occasionally display a tendency to become vesicular. Some of the lesions may be very like variolous lesions of the age of a day or two, and the resemblance is furthered by the association of the eruption with febrile disturbance and pain in the joints. Nevertheless, even if there are no definite rheumatic symptoms and no grossly discordant lesions, it is seldom that the patient does not exhibit among the rest some lesions which are plainly purpuric or urticarial. (Plate XCVII., Fig. 1.)

Erythema nummulare—Erythema bullosum.—In exceptional instances of mistaken diagnosis there are to be found lesions characteristic of erythema bullosum—round erythematous patches, as large as a shilling or larger, surmounted by a large vesicle. The vesicle may be full and tense, or flat and empty, and is encircled by a red zone. If the vesicle be flat, the pellicle may be of a pearl-grey colour throughout, or may be discoloured at the centre by partial incrustation or by pigmentation of the skin below. When such examples of the malady are confused with smallpox, the

confusion arises in spite of, and not because of, the presence of the characteristic lesions, for these are associated with other lesions having but a feeble resemblance to the prototype. These less typical lesions are more plentiful. They are circular erythematous discs of smaller size, some or most of which display a small central vesicle. It is more common to see cases in which the characteristic bullous lesions are absent, the eruption being composed entirely of elements of the character last described. In other cases the vesicles are altogether wanting, and the patient presents a crop of erythematous discs slightly raised, like pink wafers stuck upon the skin. (Plate xcvi.) The cases considered in this paragraph, in fact, form a series, at the head of which stand those to which the terms erythema bullosum or erythema iris may be more aptly applied. The lesions of no member of the series have any real resemblance to those of smallpox, being too soft and superficial.

All the foregoing varieties of erythema differ from the variolous eruption in the circumstance that their favourite situations are the limbs, especially the extensor surfaces, while the trunk and, above all, the face show but little liability to be affected. Thus erythema bullosum and the allied eruptions affect the extensor surfaces of the forearms, the legs suffer less often, and the rash seldom extends to the trunk. Erythema rheumaticum is generally confined to the legs; and though the rash may come on the arms and trunk, lesions occur upon the face only exceptionally. The face is the seat of a simple purpura more frequently, but even with that eruption the limbs are the more favourite choice.

Erythema multiforme—Acute urticaria.—The generic term, erythema multiforme, is restricted here to some varieties of erythema which differ in certain particulars from those hitherto mentioned. The eruption, as a rule, is more profuse; it is more catholic in its choice of situation; and from case to case, and even in the same case, there is more diversity in the character of the elements. It is not necessary to insist on these differences; the classification of the erythemata, to a

great extent, is arbitrary. But since the circumstance tends to influence the judgment at the bedside, it is well to recognise that different cases of simple erythema of all kinds, and of erythema multiforme in particular, may have a widely different clinical aspect.

Among the cases which are liable to be mistaken for smallpox there is, naturally, not the same scope for variety of lesion. The bulk of the eruption is composed of papules or macules comparable in point of size with the lesions of smallpox or of measles. When the rash consists wholly of papules which are distinct and prominent, an event which is more likely to occur when the rash is not very profuse, the disorder may be called erythema papulatum. (Plates XCVIII., Fig. 2, and XCIX.) More often, the eruption consists in one place of firm and prominent papules, in another of soft flat lesions which, if they are near together, blend with one another as do the papules of measles. (Plates XXXII. and XXXIII., Fig. 1.) In other cases, again, all or most of the lesions are of the latter character. Sometimes the papules lie in a diffuse erythematous matrix, with which in places, losing their individuality, they may become completely merged. (Plate CI., Fig. 1.) Another difference from smallpox may not infrequently be found in the presence of a few very large papules or tubercles which would obviously be foreign to a papular variolous eruption.

A trait which is particularly apt to engender suspicion is the tendency, which often exists, for some of the lesions to take on an appearance as of impending vesiculation. The formation of definite vesicles with serous contents is less common, and, when it occurs, is generally slight in extent. In very exceptional cases, however, that feature is conspicuous and is displayed by a large number of the lesions, so that parts of the surface may be occupied by a vesicular eruption, to the exclusion of the papular elements. (Plates XCVII., Fig. 2, and XCVIII., Fig. 1.) The vesicles are superficial. In other cases some of the lesions become urticarial, and the eruption may be described as a compound of urticarial and erythematous papules. Or the rash may be wholly, or almost

wholly, of an urticarial character and may be called an acute urticaria. (Plates CI., Fig. 2, CII. and CIII.)

Aberrations from the variolous type of lesion, though evident when sought for, may not be very conspicuous on the surface; and at first sight some of these eruptions, associated as they are apt to be with febrile symptoms, may be exceedingly suggestive. The aspect of the case varies with the profuseness of the rash, which may suggest a trivial or a serious attack. As with other forms of erythema, the incidence of the rash may be chiefly on the limbs; but it is frequently much more widely diffused. (Plates C. and XXXI.) And not only may the rash be abundant upon the face but the lesions may appear even upon the palate. The order of incidence, however, is seldom the same as with smallpox, and as a rule the diffusion of the eruption is incomplete. All varieties of the disorder run a similar course and the patient is quit of his symptoms after a few days. During involution the rash loses all its mimetic qualities.

Acute febrile erythema.—Experience teaches that the various kinds of simple erythema are closely related, and suggests that the difference of anatomical character among these rashes is due as much to personal idiosyncrasy as to difference of ultimate cause. The several varieties which may be separated are to be regarded as types only, and are linked together by many intermediate forms. It is, therefore, not to be inferred that the cases grouped under the title of acute febrile erythema are capable of distinct separation, pathologically or clinically. They are merely extreme examples of erythema multiforme, and are separated only because it is a common custom completely to misinterpret their character.

The pathology of the whole group of simple erythemata is very imperfectly understood. That most cases are rheumatic, there is no evidence to show; even with those which would be generally classed as examples of erythema rheumaticum the evidence of rheumatism is often incomplete. Excepting those instances in which the erythema is secondary to an infection or to the ingestion of a poisonous drug or a poisonous food, we are in ignorance of the cause of most of

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these eruptions and can conclude only that they are toxæmic. That the rash is an expression of a toxæmia is in harmony with the fact that it is commonly associated with and often preceded by febrile symptoms, symptoms which are peculiarly distinct in the cases now to be discussed.

While it would not be accurate to say that with cases of erythema multiforme the severity of the constitutional symptoms is in proportion to the abundance of the eruption, it is a fact that when those symptoms are unusually prominent the eruption is generally profuse. Cases occur, by no means infrequently, in which the patient displays an eruption covering the whole or the major part of the cutaneous surface, and exhibits febrile symptoms which are so pronounced as to be most suggestive of the onset of an acute specific fever. The onset of illness is distinct and may be sudden, and frequently precedes, perhaps by as much as two or three days, the outcrop of the rash. The fever may be considerable, and the temperature may reach 103°, 104°, or even 105°. The patient feels ill and usually suffers from headache, which is sometimes severe, and from pain in the limbs. With some cases there is nausea or vomiting; these symptoms are occasionally very prominent, and may be associated with diarrhœa. The tongue is furred, and the patient may complain of sore throat, examination revealing injection of the soft palate and fauces; but sore throat is a symptom only in a minority of the cases. In exceptional instances the illness is alarming. The fever runs high and there may be delirium. The patient is prostrate, has a dry tremulous tongue, and appears to be in danger of succumbing. Yet, in the author's experience, such symptoms are illusory, and all cases end alike. Within a week the symptoms abate, the rash begins to fade, and recovery is uninterrupted and rapid. The following is an example of a case of moderate severity.

N. D., aged 20, a gasfitter's labourer, previously in good health, developed the rash on the third day of his illness. During the first two days he had to give up his work, stay at home and lie down. He had pains in the legs, arms, and shoulders, and suffered from frontal headache. He was sleepless and lost his appetite. On the third and fourth

days of the attack he complained of sore throat. He came under observation on the fourth day. He was flushed and perspiring. The lips were full and dry and rather tremulous. The tongue was moist and covered with a white fur. There was slight faucial injection. The temperature was 103°.

There was a discontinuous erythematous rash. This was most abundant on the limbs, especially at the distal ends. It was very thick on the backs of the hands, wrists, and feet. Higher up the limbs, the spots thinned out. The rash was present on the face, but not so abundantly as on the limbs. It was least abundant on the trunk, but was as pronounced in front as behind. There were a few spots on the hard palate.

The rash was dark red. For the most part it was made up of small round spots, many about a quarter-inch across, many smaller. Most of these spots were slightly raised. All were soft. The resemblance to the papules of measles in some instances was very close. But some of the papules looked as if about to become vesicular, and in a few places there were small vesicles with serous contents lying on a raised erythematous base. In other places the elements of the rash were lost in a patch of diffuse erythema. The hands and feet were slightly œdematous. On the fifth day of illness the rash began to fade and the symptoms abated. The patient made a speedy recovery.

Except that they are superabundant, these eruptions do not differ in their characteristics from those of other forms of erythema multiforme, and they are as easily separable from a papular variolous rash. In many cases the eruption is extraordinarily profuse and covers the whole body. Examples of such rashes figure in the plates. (CIV., CV., CVI., and CVII.) Profound constitutional disturbance and an abundant eruption covering face and trunk as well as limbs are a combination which is especially deceptive; but such universal eruptions can, at the worst, be as easily separated by their distribution as a profuse eruption of measles.

It is for measles, indeed, that acute febrile erythema is most frequently mistaken, and the plates will show how close may be the resemblance. Most patients, suffering from acute febrile erythema, who have come under the author's observation have been young adults, but such patients have been certified for smallpox, and most patients with measles who earn certificates of smallpox are young adults also. There is no reason to suppose that acute febrile erythema has a

different age-incidence from other forms of simple erythema, and therefore that there is a distinct difference from measles upon that score. The following may be regarded as the chief clinical distinctions between the two maladies. The interval between the onset of illness and the outcrop of the rash is usually shorter with acute febrile erythema, and may be altogether wanting. The efflorescence of the rash generally proceeds differently with the two diseases; the eruption of measles begins on the face and spreads downwards, but with the simple erythema there is no such constant proclivity. In many cases, too, the order of incidence is different, the limbs, with the simple erythema, often suffering more than the face and trunk; in some cases of acute febrile erythema, however, the rash is so profuse that no such difference is apparent. With measles it is but rarely that there is a tendency to the development of vesicles or pseudo-vesicles, whereas that tendency is a common feature of the other eruption. Again, the rash of measles is regular and uniform, but the simple erythema is often irregular and multiform. A most important and essential characteristic is the prominence of catarrhal symptoms with measles. Though with the other disorder there may be sore throat, pronounced catarrhal symptoms are almost always wanting. Lesions which could be mistaken for Koplik's spots are not found in the mouth with simple erythema, but it should be remembered that erythematous spots may be found upon the palate.

The differential diagnosis from measles has been discussed because it must often have appeared to the observer that the choice in diagnosis lay between smallpox and measles, instead of between smallpox and a third disease. A widely diffused erythema, accompanied by febrile symptoms, is not necessarily symptomatic of an acute specific fever.

CHAPTER XV

CHICKENPOX

CHICKENPOX is mistaken for smallpox about half as frequently as all other diseases combined. In the majority of cases the resemblance is superficial only; but there are some in which the lesions approximate in character so closely to those met with in many cases of the graver disease that the distinction would be very difficult, did it turn only upon the symptoms and upon the character of the spots. Fortunately the eruption of each disease has so much individuality of distribution that it is only when the rash is scanty, and when there is a dearth of evidence of any kind, that the judgment need be seriously in doubt.

Chickenpox is a disease of childhood, and smallpox, at the present day, a disease of adults. That to this rule there are many exceptions is, perhaps, not fully realised, for many adult patients are wrongly certified. Chickenpox is not uncommon among adults, and occurs up to middle age; and adults get by no means sparse eruptions. (Plates XXIX., CX., and CXI.) The disease is as easy of recognition in their cases as in the cases of children; but not infrequently the decision has rested, it would appear, not upon the evidence, which was unambiguous, but just upon the mathematical probability. Contrariwise, smallpox is sometimes mistaken for chickenpox, not so much from the inherent difficulty of the case, as because the patient happens to be a child, and chickenpox a disease of childhood.

The method of onset of the illness is as insecure a guide as the age of the patient. The eruption of smallpox is usually preceded by a period of fever, and the fever of chickenpox is generally coincident with the outcrop of the rash. Not infrequently, however, the eruption of chicken-

pox is preceded by fever and malaise; indeed, in rare cases there is, as is so often the case with smallpox, a prodromal or a coincident erythema.*

On the other hand, in cases of smallpox of the milder sort the outcrop of the rash may be the first symptom to be displayed. The presence or absence of precedent febrile symptoms is, in fact, not of much account in the class of cases which fall to be distinguished. Nor is there much significance in the amount of fever which accompanies or succeeds the efflorescence.

The eruption.—Much weight should not be attached to the mere density of the eruption. Though confluent chickenpox is highly exceptional, the rash, not infrequently, is developed in surprising quantity, and vesicles, here and there, may be coherent.

In most cases the lesions of chickenpox seem to begin as vesicles; yet, probably, such is not really the case. If the rash be seen early enough, there may generally be observed among the vesicles some small papules, soft, hardly raised above the surface—for the most part mere flecks. These papules are so evanescent that the vesicles seem to start, ready made, from the skin. Yet in some cases the papules are larger, better formed, and longer lived. The rash then may be said to pass through a distinct papular stage; and if the patient be seen on the day of outcrop he may exhibit a rash wholly papular, and have an exceptional opportunity of earning a certificate of smallpox.

Character of the lesions.—The differential diagnosis of the two diseases must almost always be determined by the evidence presented by the eruption, and the trend of custom, perhaps, is to give undue weight to the character of the lesions, or rather to certain traits of character. This body of evidence, certainly, is of the greatest moment, but it is necessary to keep the component features in perspective. Just as with smallpox the salient feature is that the

* For an account of the accidental rashes of chickenpox, *see* J. D. Rolleston, *British Medical Journal*, May 4th, 1907.

focus of the lesion lies deep among the epidermal cells, so with chickenpox it is that the focus lies immediately beneath the cuticle. And by as much as either disease departs from that rule, by so much do its lesions approximate in character to those of the other.

That the lesions of chickenpox are rooted near the surface can generally be made out best by inspection and manipulation. The exceedingly superficial and fragile-looking vesicles which doubtless suggested such names as glass-pox and *Windpocken*, though common enough in practice, are not often seen in cases which are likely to be misinterpreted. Yet, even though the vesicles be somewhat more deeply placed, the distinction in position between the lesions of the two diseases is generally very easy to appreciate. (Plate CVIII.) Even when the spots have dried up the difference can generally be perceived between the scabs of chickenpox adhering to the surface and the counter-sunk scabs of smallpox.

Interpreted, not as a specific sign, but merely as additional evidence of the position of the lesion, there is no objection to regarding the absence of loculation in the vesicle as a feature of the disease. But it must be remembered that a few multilocular vesicles are met with sometimes in cases of chickenpox, and that unilocular vesicles are not an uncommon feature of smallpox.

An interesting characteristic of the disease is the oval outline which some of the vesicles are apt to assume. The vesicle is formed by the effusion of fluid beneath the horny cuticle. Where the skin is thrown habitually into folds or wrinkles the cuticle is stripped more easily in the direction of the fold than across it, and the vesicle tends to increase in the one direction more than in the other. Vesicles of this shape, therefore, are most likely to be met with in situations where the creasing is pronounced; that is to say, in the neighbourhood of the flexures; and the long diameter of the vesicle will lie in the direction of the crease. (Plate CIX.)

A peculiarity which may be observed still more frequently is that many of the vesicles have not so much an

oval as a jagged or irregular outline. (Plate CVIII., Fig. 2.) The same explanation holds good, probably, for all these deviations from the circular shape: the resistance to the expansion of the vesicle is different in different directions, on account of the criss-cross of lines and wrinkles into which the skin habitually falls.

That an oval or irregular outline is less frequently displayed by the vesicles of smallpox is due, doubtless, to the circumstance that among the deeper strata of the skin the wrinkling of the surface would have less influence in modifying the equal expansion of the vesicle. Variolous vesicles, at any rate, are more liable to depart from the circular outline when they are unusually superficial. (Plate CVIII., Fig. 1.) For the reason that sometimes they do so depart, the evidence from outline must not be pressed too far; such evidence, indeed, is merely additional evidence of position. Yet an elongated outline to some of the lesions is evidence of chickenpox which is especially useful when the patient has not come under observation until the lesions have become encrusted and the other characteristics have become obscure.

With regard to all these signs it must be remembered that the extent to which they can be relied upon depends upon the prominence which they may attain. Cases of modified smallpox occur, exceptionally, in which all the lesions, or most of them, display a character more appropriate to chickenpox. On the other hand, lesions of chickenpox are to be encountered which are every bit as deep as those seen in very many cases of smallpox. Chickenpox often leaves scars, and what better proof could there be of the depth to which its lesions may penetrate? But in cases of each disease it happens generally that, though in places the character of the lesions may be discordant, yet on the whole the trend of evidence is in the right direction.

Two other minor characteristics distinguish the eruption of chickenpox: the absence of umbilication of the vesicles and the efflorescence of vesicles in successive crops, or, in other words, the presence of lesions in different stages of evolution. A lack of homogeneity among the lesions must

not always be expected of chickenpox; and, when it exists, is not necessarily valid evidence against smallpox. The aggregation of lesions of a different age tells against the latter only under the conditions detailed in Chapter VIII. (p. 51). Indentation of a number of vesicles is good evidence against chickenpox, but not the dimpling of a few. The absence of this sign counts nothing either way.

Distribution.—As there is no part of the body on which the lesions of smallpox may not appear, so there is no part which is incapable of developing the vesicles of chickenpox. They may come on any part of the trunk, limbs, and head, on the palms and the soles, the scalp and the ears, the palate and the buccal mucous membrane. Nevertheless, the rash, hardly less than that of smallpox, shows its individuality by the choice of favourite situations.

The seat of election is the trunk of the body, and the rash may be limited to that part almost entirely. More often it comes also on the face; and sometimes is as dense there as on the trunk. (Plates CX., CXI., CXII.) Smallpox chooses the face before all, next the arms, thirdly the back or legs. While smallpox least affects the front of the trunk, the eruption of chickenpox is often as abundant there as on the back, or more abundant. While the variolous rash is more abundant on the shoulders than over the loins, and more abundant on the chest than on the abdomen, that of chickenpox displays no such constant difference. Unlike smallpox, chickenpox tends to avoid the limbs, and if the rash affects them, it shows no preference for the extensor surfaces. Its density, besides, increases from below upwards—the distribution is centripetal; whereas with smallpox the density increases from above downwards—the distribution is centrifugal. The larger and better developed variolous spots come at the ends of the limbs where the rash is densest; with chickenpox, on the contrary, vesicles which occur at the ends of the limbs tend not only to be sparse, but also to be small and ill developed.

In applying these considerations to a particular case, it is necessary to weigh the evidence as a whole and not to seize

upon one part of it as being essential. Both diseases have anomalies of distribution. In the milder and more modified cases of smallpox, for instance, it happens sometimes that the upper limbs or the lower carry less than their wonted share of the rash, and that it is disposed after a fashion which is centripetal rather than centrifugal. Yet the disposition of the rash over the rest of the body will conform to the usual law. A case of chickenpox may be remarkable because the rash is unusually abundant on the limbs (Plate CXIII.); or because, although the rash is scanty on the limbs, a few well-developed vesicles or pustules are seen at their extremities, for example on the hands or soles. But the presence of a rash of some density on the limbs, or of a few fat pustules on the hands or soles, is by no means inconsistent with chickenpox. Again, it is unusual in cases of chickenpox for the rash to be much denser on the face than on the trunk of the body, or for it to be much denser on the back than on the front of the trunk, or denser on the shoulders or on the chest than over the loins or on the abdomen. (Plates XXIX. and CXII.) Yet those events, happening singly, would not upset the balance of evidence. Similarly, smallpox is more apt than chickenpox to affect the buccal mucous membrane; but with chickenpox a few vesicles are to be encountered very commonly in that situation, and occasionally they are present in some abundance.

It is to be remembered that the eruption of chickenpox is more liable than that of smallpox to be unstable or capricious in distribution. The rash has affinities, but the bonds are readily stretched or broken. It is less unusual, therefore, for chickenpox to deviate so far from the type as to mimic the distribution of smallpox than for a variolous rash to approach closely to the common pattern of chickenpox. (Plate CXIII.) Occasionally chickenpox imitates smallpox even by responding to cutaneous irritation. (Plate XXXVI., Fig. 1.) Yet, however specious may be the general similarity displayed by such anomalous cases, there will be material outstanding differences. The gradations in density, for instance, though right in kind may be insufficient in degree; the rash will not be shy of the armpits and groins; nor will it map out the con-

tours of the surface on the face, the neck, the bust, or on other parts of the body. (Plates XXIX., CXII., and CXIV., Fig. 1.) All these points, which are of great importance to the differentiation of the two diseases, have been fully discussed in earlier chapters.

When the eruption is scanty, difficulties in diagnosis begin to arise; for then the evidence from distribution is less complete. If, at the same time, the lesions should be small and should have become encrusted, circumstances under which their character may be difficult to appreciate, the trouble then may be formidable. In such event, it is probably safer to be guided by the disposition of the few spots that can be seen, than by the character which they may be assumed to possess. (Plate XXXVI., Fig. 2.) It is only in such cases that it is right to be much influenced by that circumstantial evidence from which it is so difficult to turn the mind—the presence or absence of either disease in the neighbourhood, the age of the patient, and his state in respect of vaccination.

Summary.—To conclude this account, the chief points of difference between the two diseases are enumerated in the following summary:—

SMALLPOX	CHICKENPOX
1. The rash is most abundant on the face; most scanty on the abdomen and chest.	1. The abdomen and chest are covered as thickly as the face, or more thickly.
2. The rash is much more abundant on the back than on the abdomen.	2. The abdomen is covered equally with the back.
3. The rash is more abundant on the shoulders than across the loins, and on the chest than on the abdomen.	3. The distribution is indifferent.
4. The rash favours the limbs; and, generally, the arms next to the face.	4. The rash tends to avoid the limbs.
5. The distribution on the limbs is centrifugal.	5. The distribution on the limbs is centripetal.
6. The rash favours prominences, and surfaces exposed to irritation; it tends to avoid protected surfaces, flexures, and depressions.	6. The rash behaves indifferently.

SMALLPOX—*continued.*	CHICKENPOX—*continued.*
7. The lesions are deep-seated, and have an infiltrated base.	7. The lesions are superficial, and the base is not infiltrated.
8. The lesions are generally circular in outline.	8. The lesions frequently have an irregular outline; when they lie near a flexure, they are apt to be oval or elongated.
9. The lesions are homogeneous in character; or, if they are heterogeneous, they are heterogeneous by law (Chapter VIII., p. 52).	9. The lesions, often, are not homogeneous; and the want of homogeneity bears no relation to the sizes of the lesions and to their situation.
10. The vesicles, generally, are multilocular.	10. The vesicles, generally, are unilocular.
11. Frequently some of the vesicles are indented.	11. The vesicles are never indented and seldom dimpled.

CHAPTER XVI

SYPHILIS—VACCINIA

Syphilis.—This disease, which mimics all things, mimics smallpox; and though it furnishes some of the easiest, furnishes also the most difficult cases to distinguish. In most cases the patient presents a papular or a pustular eruption. The syphilitic roseola, as might be supposed, is not often mimetic. Vesicular syphilides, though uncommon, might reasonably be expected, when they do occur, sometimes to pass themselves off as variolous eruptions; the more so as one variety has been distinguished by the epithet "varioliform." Yet such a tendency does not appear to exist, or is exhibited but rarely.

The roseola, the earliest of the secondary syphilides, consists of macules or erythematous blotches scattered, mostly, over the front part of the trunk and the flexor surfaces of the limbs. In that guise it is, therefore, wholly unlike a papular variolous rash, either in character or in distribution. Yet there are cases in which the macules are smaller, more prominent, profusely developed and covering almost the whole surface of the body including the face. If such an eruption be ushered in or accompanied by fever and febrile symptoms, as may very well be the case, a precipitate observer might suppose that he had to do with an acute specific fever, and make a diagnosis of measles or of smallpox. With syphilis in the mind, it is not difficult to detect the imposture. The chancre, it may be, has only to be looked for; and commonly there are not wanting other characteristic signs. Smallpox, at any rate, can be readily eliminated by the softness of the lesions, if not by their size, by their lack of uniformity of character, and by the anomalies of distribution which are no less obvious when the rash is profuse than when it is scanty.

With many examples of papular and pustular syphiloderms the rash is of sudden development, and, if abundant, its outcrop is not infrequently attended by noteworthy constitutional symptoms. It may happen, therefore, with these eruptions, as with the roseola, that the general character of the illness may be something after the style of an acute specific fever. In other cases the facts are not so; and in all cases the sequel differs from the after-history of a case of smallpox. Yet, for reasons which will be discussed in the next chapter, such considerations may be of little practical value at the moment; and though they may find their application in suitable circumstances, it will not be worth while to be occupied with them here.

Of the papular syphilides some examples figure in the illustrations. (Plates CXIV., Fig. 2, CXV. and CXVI.) The rash may be profuse and may cover almost the whole body, but its incidence is frequently limited and it is apt to be disposed in patches. Unlike the roseola, the papular syphilide frequently affects the face, and in that respect resembles smallpox; but there is never a close resemblance in the incidence of the eruptions of the two diseases. In some cases the individual papules approximate in character to the variolous papule; and if attention be concentrated on that circumstance to the exclusion of other evidence, the fact may be found deceptive. Yet in most cases distinguishing characteristics are not wanting to the lesions; such as their size or their shape—syphilitic papules are apt to be eccentric in outline and flat-topped—the presence of scales, the colour, or the association with such exotic lesions as nodules or tubercles or squames.

Most frequently the syphiloderm to be distinguished consists chiefly or entirely of pustular lesions. (Plates CXVII. and LXVI.) As with the papular syphilides, so with the pustular, the discrimination is easy in proportion as the lesions are polymorphous. Sometimes a few discordant lesions, like ulcers or rupial crusts, may be detected among the rest; and though such pronounced polymorphism may be absent, still there may be too much diversity of character. The lesions of smallpox are not always homogeneous; but it would be

against such a diagnosis to find pustules and well-developed papules co-existing, or small pustules lying side by side with large crusts. Again, some of the pustules may be too large, or there may be too much diversity of size, or some of them may be too irregular in outline.

The position in the skin which the lesion occupies is important to determine, and may be a valuable distinguishing feature. A syphilitic sore, especially if it is not lacking in size, may dip down deeply into the corium or even to the subcutaneous tissue, and may be distinguished by its bulging shape and by the induration about its base. The presence of even a few lesions of such a character might be distinctive. Less frequently, the pustule is too superficial, being little more than a bleb or crust upon the surface. But most of the lesions of secondary syphiloderms, whether papular or pustular, occupy the papillary layer of the skin or are embedded deeply among the epidermal cells. They occupy, that is to say, a position indistinguishable from that of the variolous lesion. And though, because the inflammatory process is less acute, they may lack resistance to the touch and feel softer than do the papules and pustules of smallpox, yet of such small differences of resistance it is very difficult to make sure.

The circumstance that the lesions may occupy an indifferent position in the skin causes some cases of syphilis to be extraordinarily difficult to distinguish; but for the difficulty to arise the rash must be scanty. When the eruption is profuse, not only may telling differences of character be found among the lesions, but abundant evidence will be furnished also by their distribution. If, instead of being, as is frequently the case, patchy or elliptical in its incidence, the rash is broad-cast and uniformly indiscriminate in its choice of situation, that lack of discrimination should betray it. And should it happen, as occasionally it must, that the distribution bears in outline a specious resemblance to the variolous pattern, yet even then, unless the rash be scanty, it will be very easy to find discrepancies in points of detail.

Scanty pustular syphilides may be encountered, whose lesions are of uniform character and do not differ materially

from those of many cases of modified smallpox. To distinguish such cases by the evidence furnished by the eruption alone, it would therefore be necessary to rely wholly upon the distribution. Commonly the rash is either of limited extent or else faulty in its order of choice. But it is clear that occasionally the characteristics of the eruption will be indecisive, and that it will be necessary to cast about for other evidence. The patient may exhibit other symptoms of syphilis, or there may be signs of previous syphilitic eruptions, such as small scars or pigment-marks. An analysis of the personal history may help, but whether the disease be syphilis or smallpox it will be equally unlikely for the constitutional symptoms to have been prominent; and should the history suggest, or should the patient admit, a past attack of syphilis, it will not follow necessarily that because he has once had syphilis he has not now got smallpox. Fortunately the cases are very exceptional of which the difficulties of diagnosis are so profound.

Vaccinia.—It is more from the difficulty than the frequency of the problems to which they give rise that vaccinal eruptions derive their importance. It would seem that there is no temptation to attribute a vaccinal rash to smallpox unless the patient has been exposed to infection from that disease. The usual train of events is that a case of smallpox occurs in a house and that the inmates are successfully re-vaccinated; after an interval one of them develops an eruption, and the question then arises, is the rash variolous or vaccinal?

Before passing to the generalised vaccinal eruptions, the conditions produced by supernumerary vaccine-pustules and the pustules of auto-inoculation deserve a word. It has been shown (Plate I., Fig. 2) that the irritation of a successful vaccine-inoculation, done during the period of incubation of smallpox, is capable of producing a condition which resembles closely that caused by the development of supplementary vaccine-pustules round the place of original inoculation. The event may happen in a case of smallpox even when the eruption is elsewhere so scanty as to concentrate attention

almost exclusively on the arm. There may be some similarity, therefore, between a condition caused by the conjunction of the two causes, smallpox and vaccination, and that caused by vaccination only; but it is more likely for the former to be mistaken for the latter than the reverse. Vaccinal pustules of accidental inoculation, occurring elsewhere than in the neighbourhood of the original sore, may be distinguished from ordinary variolous pustules by their irregularity of shape and of distribution; but it may be recalled that smallpox itself may be conveyed accidentally by inoculation, for example, from a mother to the child. (Chapter VIII., p. 53.)

The accidental and unspecific eruptions which occur after vaccination need not be discussed, nor the erythematous rashes of general distribution which are doubtless caused by the circulation in the blood-stream of the secondary products of inflammation absorbed from the vaccine-pustule. But there are to be encountered other generalised eruptions which are composed of distinct elements, and occasionally set problems in diagnosis which are almost insoluble. One difficulty of the matter is occasioned by the rarity of such rashes. It is, at least, to be supposed that they are rare. Public vaccinators appear to have little experience of them, and the accounts in the text-books and periodicals are meagre and unsatisfying. It would not be expected that vaccinal rashes should often be seen in the receiving-room of a smallpox hospital, but they are seen by no means so rarely as the general experience would lead one to suppose. Perhaps the truth is that the rash is so inconspicuous that it escapes attention except when the fear arises that it may be infectious.

Wanting better information, generalised particulate vaccinal rashes may be divided into two groups. In the first may be placed those which are composed of small superficial papules (vaccinal lichen), or of minute vesicles, or of a mixture of these elements. It is probable that these lesions are toxæmic, and are not evidence of a generalisation of the specific virus. The subject is generally a child, and the rash may be

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quite profuse. The lesions are too small and superficial to be variolous, and there is no tendency to imitate smallpox in distribution. In the second group may be placed eruptions whose elements have a closer resemblance to variolous lesions. Ordinarily the rash is sparse. The lesion may be described as a small pimple with a vesicular or pustular head, superficial in position, but not more so than the more superficial of the lesions which may be encountered in cases of modified smallpox. There is this difference, that with modified smallpox, even with the cases which are exceptionally mild, some of the lesions will be more deeply placed, whereas with vaccinia all are superficial. Yet there remains a difficulty: it cannot be denied that it is possible for a variolous eruption to occur, very scanty and modified to an exceptional degree, all of whose lesions shall be as atypical as those of vaccinia. And assuming a particular case to be an example of smallpox and not of vaccinia, a highly modified eruption would be expected, since the patient, by hypothesis, would have been successfully vaccinated during the period of incubation. Vaccinal eruptions have been recorded which were more abundant, and whose lesions were larger and nearer in character to those of the modified variolous rashes more commonly encountered. There is no reason to question the occurrence of such eruptions; indeed, their occurrence might be expected; but they are undoubtedly of the utmost rarity, and the author has had no experience of them.

Under such circumstances, how can it be decided that the patient has not got smallpox? Since he must be immune both to smallpox and to vaccinia, no crucial test can be applied. But in some, at least, of these cases the arrangement of the lesions is not such as might be expected if the patient had smallpox. They are prone to affect the trunk, and their distribution is less akin to that of smallpox than to that of chickenpox. It is curious that this should be so, since it seems probable that the vaccinal and variolous eruptions have the same pathology. Should no such distinct difference appear, the case would be best treated as one of the grave disease.

It may happen that circumstantial evidence opposes a diagnosis of smallpox. If the date of exposure to variolous infection is known, that diagnosis might have to assume too long a period of incubation. If the interval between the exposure and the outcrop were more than sixteen or less than twelve days, the rash would be more likely to be vaccinal. Or assistance may be derived from the duration of the period between vaccination and the outcrop of the rash. If the outcrop occurred as late as ten days after the date of first reaction to the vaccinal inoculation, the odds against smallpox would be considerable. But the vaccinal eruption is developed, generally, when the local reaction is at its height, that is to say, at the end of the first week after inoculation; and such an interval is too short to preclude the possibility of the eruption being the bloom of a variolous infection previously ingrained.

CHAPTER XVII

DERMATITIS—PUSTULAR DERMATOSES

The less frequent misinterpretations.—Besides those dermatoses, to be noticed presently, which are capable of assuming at least a superficial resemblance to the eruption of smallpox, there are many others which are mistaken rarely, or through accidental circumstances, yet are of considerable importance in the aggregate.

In many of these cases the patient suffers really from a constitutional disorder. Such a misapprehension, as might be expected, occurs chiefly when smallpox is rife. It may happen, indeed, and often does happen, that the patient has symptoms of illness but never any eruption; he is certified on suspicion, because he is known to have been exposed to variolous contagion. But we are concerned rather with the patient who is certified in good faith because he suffers from some disorder which is associated with a skin-eruption, but associated by accident. It may seem strange that such diseases as acute rheumatism, acute tuberculosis, or pneumonia should be mistaken for smallpox. Yet to everyone in practice it occurs, at the onset of an acute disease, to have to debate the alternative diagnosis of an acute specific fever. Suppose, then, that a close examination reveals the presence even of a few pimples, freshly developed or not previously noticed; is it surprising, smallpox being about, that smallpox should sometimes be suspected?

In some instances the eruption is really a consequence of the constitutional disorder, though the disease is one which is not usually signalised by an eruption. The affection of the skin will be due, probably, to some contamination of the blood-stream. Thus the patient may be suffering from Bright's disease, complicated, perhaps, by uræmia; or he may

be a victim of ulcerative endocarditis or of some other form of pyæmia. It should not be forgotten that a disease which is peculiarly liable to evoke a pustular skin-eruption is diabetes. Occasionally the patient is the subject of a disease of the nervous system, such as acute mania, or cerebral abcess, or meningitis, and the associated eruption may be toxæmic or may possibly be trophic. The mention of the last disease suggests that were epidemic meningitis commoner the eruptions which are a feature of it might sometimes cause it to be mistaken. Another eruptive fever which perhaps owes to its rarity its immunity from a similar misapprehension is glanders.

On the other hand, the patient may suffer from a skin-disease, uncomplicated, one which in general bears no resemblance to smallpox and owes its misapprehension to accidental features of its own rather than to its associations. An eruption of small boils may be associated with another malady; but sometimes the patient has no other disorder, and suspicion was aroused by the suddenness of the attack, the presence of febrile disturbance, and the wide dissemination of the lesions. Though herpes zoster is unsymmetrical in distribution, and therefore wholly alien in character, yet it appears with some constancy in a long series of cases of mistaken diagnosis; in the deceptive cases the eruption is generally of unusual extent and unusual distribution. Another disease occasionally mistaken is pemphigus, the accident being more likely to occur when the bullæ are abnormally small.

The catalogue is not exhaustive, but there would be no object in extending it. In none of the instances is there a close resemblance to smallpox, and no great art is required for the distinction. The diagnosis has often been arrived at by the process of exclusion. But not all the eruptions to which the race is subject are systematised in the text-books or are within the experience of any physician; and while it may be easy to assert that the patient has not got smallpox, it may be impossible to tell the real disease from which he suffers.

Antecedent symptoms.—In some of the cases suggested

above, the observer has been misled by the associated symptoms. It is not well that, with a pustular eruption, much weight should be attached to these. When an eruption is nascent, or when it is erythematous or hæmorrhagic in character, the associated symptoms, because of the dearth of evidence, may be of importance. But a pustular eruption furnishes evidence which far outweighs that which may be derived from other sources, and, unless they are such as to lift smallpox clean out of the category of possible diseases, the associated or antecedent symptoms are of insignificant value.

Even the absence of antecedent symptoms counts for little. It will be observed that many of the dermatoses presently to be noticed are afebrile. But in most of those instances the eruption is not very profuse; and it is by no means uncommon for scanty variolous eruptions to be preceded by toxæmic symptoms which have been evanescent or wholly disregarded. Of what use, then, would it be to instance as a distinguishing feature between smallpox and impetigo, that the eruption is preceded in one case by fever and constitutional disturbance but not in the other? Besides, as mentioned before, the association with constitutional disturbance of an eruption, ordinarily afebrile, may be accidental. A pustular syphilide may acquire a specious resemblance to smallpox from the onset of an attack of influenza, or a drug-rash from the symptoms of the disease for which the drug was prescribed.

Still more is it the case that merely the reputed absence of antecedent symptoms is of little moment. The observer, often, has not seen the patient until after the development of the rash and, for the antecedent symptoms, has to rely upon hearsay evidence. Hearsay evidence may be involuntarily deceptive, or it may be, even, that there is a deliberate attempt to deceive. It matters little whether the history relates to the absence of constitutional symptoms or to the duration of the eruption itself. It happens, not infrequently, that it is not sufficient to exclude smallpox that the eruption is of chronic course. A chronic disease must have a beginning, and may have a sudden outset; but the patient, often,

has been in possession of the rash long enough, if all were known, to put smallpox out of count. The fact is that the circumstantial evidence may be too strong. When smallpox breaks out in a house or institution everyone with a blemished skin is apt to be looked upon with suspicion. That is an attitude which cannot very well be condemned; but it follows that, in the last resort, everyone must be prepared to distinguish smallpox wholly by the character of the rash.

Acne.—This malady furnishes a striking illustration of some of the preceding remarks. It is chronic, afebrile, devoid of symptoms. Yet, next to chickenpox, it is perhaps the commonest disorder to be mistaken for smallpox.

Acne, as a rule, is easy to identify by the character of certain of the lesions, and by their limitation to the upper part of the body—the face, shoulders, back and chest. (Plate CXIX., Fig. 1.) The characteristic acne-spot is deeply rooted in the skin and its base is infiltrated and œdematous, so that the contour of the lesion is that of a broad and shallow cone. (Plate CXVIII.) Such lesions are most frequent on the upper part of the back, where they are often associated with blackheads and old scars. But most of the spots, especially those which occur on the face, are more superficial and less characteristic, and they may give a passable rendering of some of the pustules to be found in certain cases of modified smallpox.

The worst cases are the least likely to be mistaken. The diagnosis may be in doubt, either because no characteristic acne-spots and scars are present, or because it is not certain that the patient has not got smallpox as well. A close examination may reveal, indeed, certain lesions which could not possibly be produced by acne; such as vesicles, however small, for acne does not produce vesicles; flat-topped or hemispherical pustules; or disc-like scabs. Even if no such elements can be detected, the presence of spots on the legs or forearms or hands would be a highly suspicious circumstance. On the other hand, if the rash had the usual limitation of acne, the presence of a few undoubted acne-spots would almost certainly exclude smallpox; and if

the character of the lesions were wholly in doubt, such a limitation would justify the exclusion unless the rash were of the scantiest proportions, that is to say, composed of a dozen or so of spots.

Dermatitis.—*Acute eczema.*—In the instances in which this disease is misinterpreted the attack is of sudden onset and involves simultaneously a large portion of the skin. (Plate CXIX., Fig. 2.) The patient may be a child or an adult, and may or may not have been previously subject to the malady. It may be, even, that the disease was already present in a chronic form on a part of the skin affected by the fresh attack. (Plate XXVIII.) It more often happens, however, that the disease has appeared for the first time, and has been ushered in by fever and febrile symptoms. In some cases there is the further resemblance to smallpox that the eruption begins with the profuse development of small papules, which rapidly become vesicular and pustular. It takes but a short time for the disappearance of any resemblance which once existed, and at no stage of the illness can the likeness be considered close. The small size of the lesions in the majority of cases, their superficial position, and the œdema and infiltration of the skin below them, are common distinguishing features.

Impetigo.—It is not always as easy as might be supposed to tell an impetiginous eruption. An eruption of typical character, with wax-like vesicles and amber-coloured adherent crusts, this there is little temptation to confuse. In the more troublesome cases there has been a secondary infection of the follicles producing an eruption of mixed character, of which some of the pustules are deep-seated and may have some resemblance to the less typical variolous pustules. Another cause which tends to increase the difficulty of ultimate classification is that the impetiginous rash may be secondary to another form of dermatitis. Yet the diversity of character among the lesions which may be produced by these causes is a valuable means of distinction from smallpox. Some of the lesions may be obviously exotic, and a common feature is that they are too heterogeneous. (Plate CXXI., Fig. 1.) The most

difficult cases are those in which the rash is obsolescent and consists only of crusts. Something may still be told by their shape, size, and position in the skin, but the best guide will be their distribution. (Plate CXX.)

Scabies.—The vesicular and pustular eruptions which are secondary to scabies may be puzzling if their cause has been overlooked or put aside. In exceptional cases the eruption is profuse and widely disseminated, and when the subject is very young may even affect the face. The burrows may be difficult to find, but the exact identification of the disease is not of much importance to the issue, since it is seldom difficult to exclude smallpox by the more salient features of the rash. The vesicles evoked by the irritation of the parasite are much more superficial than those of smallpox; and the inherent eruption is often engrafted with a secondary dermatitis which may cause, as was mentioned in considering impetigo, considerable diversity of character among the lesions, and add to the ease of the distinction.

Traumatic dermatitis and dermatitis of obscure origin.—A variety of cases may be grouped into this section. As with scabies, the rash may be due to the depredations of parasites or insects, such as mosquitoes or lice. With susceptible subjects the bites of mosquitoes sometimes cause a very notable eruption, which may be attended by the formation of vesicles as big as a split pea. In other cases the rash is an occupation dermatitis, or is caused by some form of mechanical or chemical irritation. In some instances, though the rash may be suspected to be of traumatic origin, it may be impossible to ascertain the precise cause; and the observer must be prepared to encounter examples of pustular dermatitis the cause of which completely baffles him. (Plates XXVII. and CXXI., Fig. 2.) It by no means follows that with these unusual or anomalous forms of dermatitis the eruption is always insignificant. It may be profuse or even confluent. Such cases, though disconcerting, are the easiest to distinguish from smallpox. But commonly the rash is scanty, and its only importance lies in the fear that it may be infectious. Each case must be judged on its merits, but it is very seldom

that a variolous origin of the eruption cannot be excluded by the peculiarities of distribution.

Lichen urticatus.—Though this disorder is essentially an urticaria, it may be appropriately mentioned here, since the cases which simulate smallpox do so on account of the secondary eruption of papules or vesicles to which the urticaria gives rise. The development of vesicles is a very conspicuous feature of certain exceptional cases, and the eruption may be very profuse and widely disseminated. Lichen urticatus occurs chiefly among young children, and it might therefore be held to simulate a highly modified variolous eruption. But the lesions are almost too small and superficial to support that hypothesis, and it is very seldom that they have sufficient uniformity of character. The distribution is wholly unlike, and the malady, of course, is chronic.

Papular dermatitis.—Just as cases of pustular dermatitis are sometimes encountered which cannot be classified, so also may the event be similar when the eruption is papular and never advances beyond the papular stage of development. The eruption may be subacute or chronic. The papules are generally larger than those commonly seen in cases of papular eczema, and are not collected in groups, as with that disease, but are scattered broadcast over the surface as a discrete and somewhat scanty eruption. The incidence of the rash is seldom universal. Some of these cases are probably examples of syphilis, though no evidence of that disease may be forthcoming. Yet sometimes the subjects are children in whose cases syphilis may almost certainly be excluded. Occasionally a patient is certified for smallpox who is found, after a close examination, to be suffering from psoriasis. The mistake is possible only when the rash is in the earliest stage of its development and shows few of its special characteristics. With these cases of papular dermatitis it is evident that time would speedily demonstrate the difference, but it is generally possible to exclude smallpox, without delay, by the incompleteness of the diffusion of the rash and the comparative softness of the lesions.

Distribution.—The enumeration of the members of this group might excite surprise that confusion with smallpox should often be possible. Yet the facts are so; and it must be remembered that exceptional cases and exceptional circumstances may deceive even practised observers. What makes the discrimination easy is not that the eruptions are alien in the character of their elements, but that their distribution is so seldom consonant with that of the variolous rash. The whole group of eruptions is characterised by a partial, elliptic, or patchy incidence. Acute eczema does not affect the whole cutaneous surface, but certain portions of it suffer for the rest; the trunk, or the face, or the flexor aspects of the limbs, or a combination of these parts. Impetigo is often limited to the face and extremities, and, when it affects the trunk, the front part suffers rather than the back, the buttocks rather than the shoulders. Scabies is most likely to affect the forearms, buttocks and legs; or if the rash comes on the trunk, the lower parts suffer rather than the upper; the face is rarely affected, and only with children. The favourite situation of lichen urticatus is the lower part of the back and the buttocks; though the limbs are frequently involved, the face is not so liable to be attacked. Dermatitis from lice is an affection of the covered parts of the body; from mosquitoes of the uncovered. Psoriasis is a disease of the limbs, not of the face. Such broad distinctions are apparent in almost every case, and, even when the order of incidence is not dissonant, discrepancies in points of detail are not far to seek.

Drug-rashes.—The only drugs which need be considered are the bromide and iodide salts, both of which produce eruptions having similar characteristics. The lesion begins as a soft papule or as an erythematous macule or blotch. Presently a vesicle is formed, which rapidly becomes pustular and then encrusts. Though alike pathologically, the eruptions encountered in different cases may be of very dissimilar appearance. The lesions may be of almost uniform size, and may not differ materially in size and shape and in their course of evolution from those of smallpox or of chickenpox; but disparity of size is sometimes a conspicuous feature, and most

or all of the pustules may be a good deal larger than those of smallpox and may bear a closer resemblance to those of pemphigus. Another cause which contributes to the diversity of character among different cases is that the tendency to suppurate is not always so manifest; the evolution of the lesions is then more protracted, and they display an inclination to the development of weak granulation-tissue, so that lesions of an acneiform or fungoid character are produced. Such lesions are more characteristic of bromide rashes. Whatever may be their precise character, the pustules are generally superficial in situation and occupy a position in the skin nearer to that of the lesions of chickenpox or of impetigo; but that characteristic is not invariably pronounced. The rash is symmetrical, but is apt to be elliptic in distribution and is very frequently patchy, so that it may be confluent in one place and sparse in another. It may be profuse or altogether scanty.

These variable characteristics conduce, on the whole, to facility of discrimination from smallpox, and the majority of cases cannot very well be confused with that disease. But it is not always so. Plate XXVII., Fig. 1, gives a good idea of the kind of lesion which may have to be distinguished, though in that particular case there was no evidence to show that the rash was produced by the administration of drugs. An eruption composed of lesions of such a character, but more widely diffused, might require for its separation an intimate knowledge of the characteristics of variolous lesions and of the manner of their arrangement. Given such knowledge, drug-rashes can be differentiated from smallpox nearly always with ease and certainty. In point of fact they are not confused so frequently as might be supposed; but that circumstance is probably due less to inherent dissimilarity than to the fact that the connection between cause and effect is in most cases known to the observer. If it is not known what drugs, or that any drugs, have been administered, the exact identification of the rash may be impossible and there may be some scope for the exercise of the imagination.

CHAPTER XVIII

VACCINATION AS A FACTOR IN DIAGNOSIS

THE last piece of evidence to collect is the condition of the patient relative to vaccination. This should seldom be allowed to outweigh direct evidence as to the nature of the disease, but there are times when it is very pertinent.

The common tendency is both to underestimate and to exaggerate the capacity of vaccination to protect against smallpox. Within limits that capacity is incapable of exaggeration. A person successfully vaccinated or revaccinated acquires for a time an immunity so complete that a deliberate attempt to acquire smallpox would surely fail. But with some persons such an absolute immunity is relatively fleeting, and within a few years will have become sufficiently attenuated for an attack of smallpox to be acquired, though generally but an insignificant attack.

The briefest possible duration of absolute immunity after vaccination or revaccination may be taken, for practical purposes, to be two years. If a patient, suspected of having smallpox, could furnish undoubted evidence of a successful vaccination within such a period, the evidence against smallpox would be overwhelming. With most persons the duration of absolute immunity is more protracted. A few people acquire a life-long immunity after infantile vaccination; many persons after one successful revaccination. In rare instances immunity is still impermanent after several successful revaccinations. Should the patient display conclusive evidence of successful vaccination within five years, or of successful revaccination within ten, the weight of that evidence would be against his having smallpox. It need hardly be said that unsuccessful vaccinations do not count.*

* The fact would be difficult of proof, but it is probable that the duration of his vaccinal immunity bears some relation to the subject's inborn susceptibility,

In the application of these considerations much importance will attach to the kind of rash which the patient exhibits. With a child of five, vaccinated in infancy, supposing the diagnosis to lie between chickenpox and smallpox, the evidence would tell against smallpox if the pustules were fat and the rash abundant: if the rash were scanty and the pustules small, the evidence would be more equally balanced, even assuming on other grounds an equal probability of either disease; for though on the one hand a variolous eruption in the case of a young vaccinated child would almost necessarily be scanty and modified, on the other hand the probability of complete immunity to smallpox would be considerable. If the child were unvaccinated, the fact that the rash was abundant and the lesions well formed would count nothing either way unless the rash were actually confluent; but if the spots were small and scanty the disease would probably be chickenpox. Exceptions will occur now and then in both directions. An unvaccinated child may be insusceptible by nature, and may get an attack of modified smallpox. On the other hand, in rare cases the protection of vaccination or of revaccination suffers complete erosion within five years, and the subject might then be vulnerable even to an attack of confluent or of toxic smallpox.

In such inquiries it is important to have authentic evidence of the success of the vaccination and of its date. With children the matter is simple enough. The scars of primary vaccination never become obliterated until after the lapse of a good many years. The success of a reputed revaccination is more difficult to determine. The statements of patients are unreliable to the last degree. Scars of successful revaccination are often transitory, and sometimes the inoculation, though undoubtedly successful, leaves no scar. It may be difficult to decide, also, whether the existing scars are all infantile or are in part due to revaccination. If the vaccination was recent, the scars will be pigmented. But it must be remembered that a pigmented area, though

and that a person naturally resistant to smallpox would be likely to acquire by vaccination complete immunity of long duration; and so conversely.

not a scar, may remain for months after an unsuccessful inoculation. A pigmented or a pink scar may be taken as good evidence that a successful vaccination has been done within two years, and therefore that the patient is insusceptible.

Even at the time of vaccination it is often difficult for the operator to decide whether or not he has obtained a successful reaction. In cases of primary vaccination it is different, but everyone is familiar with the atypical reactions which may be obtained after revaccination. Operators are sometimes too easily satisfied. Though a typical vesicle, or indeed a vesicle of any kind, must not always be expected, it is a great mistake to accept as valid evidence of success an ambiguous inflammatory reaction. Localised redness and swelling of the skin under the seat of inoculation frequently follow an unsuccessful operation, and unfortunately such reactions are sometimes accepted as vaccinal. Such an erroneous assumption may be productive of the most serious risk to the subject. It has happened many times that a person, certified to have acquired protection from recent vaccination, has been proved shortly afterwards to be susceptible to a characteristic vaccinal reaction, a result which would have been impossible had the first operation been successful. When the operation is undertaken on account of exposure to infection of smallpox, a similar mistake may cost the patient dearly. Short of a definite vesicle, the only evidence which should be accepted as indicative of success is a circumscribed, deep-seated, indurated swelling of the skin under the seat of inoculation, developing about three days after the operation; and such a result should be confirmed by at least one subsequent inoculation.

If a person has been shown to be really insusceptible to vaccinia, that fact is proof positive that he is insusceptible to smallpox.* The test is of importance when there is a suspicion that a mild and unrecognised attack of smallpox

* The converse proposition does not necessarily hold good, that susceptibility to vaccinia proves previous susceptibility to the infection of smallpox conveyed through the usual channels.

has been sustained by a person who has not previously been vaccinated. The validity of the deduction rests upon the assumption, which for practical purposes may be accepted as true, that no one is born insusceptible to vaccinia.*

Vaccination after exposure.—Germane to this subject is the effect of vaccination done after exposure to infection. Vaccination, done within a day or two after exposure and followed by a normal reaction, is a certain preventive. If postponed until the latter part of the period of incubation it will be ineffectual.

The duration of the period of incubation, counting to the outcrop of the rash, may be taken as fourteen days. If this period be divided into three intervals comprising seven days, three days, and four days, then it will be accurate, in the main, to say that a successful vaccination done in the first interval will wholly prevent the attack, done in the second will have more or less effect in modifying the eruption, and done in the last will merely add to the patient's troubles.

But to this rule there are occasional exceptions. A patient may be vaccinated successfully as early as the fourteenth, or even fifteenth, day before the outcrop and yet not escape the disease; or during the first half of the incubation-period and yet develop an unmodified attack. The fact is, that the pertinent date is not when the subject is vaccinated, but when the reaction begins. Sometimes, through a peculiarity either of the lymph or of the subject, the reaction which should be manifest on the third or fourth day does not begin to arise, it may be, until a week or more after inoculation. In such a case the rise of immunity will be correspondingly deferred. It is for this reason that protection against smallpox can never be promised confidently if its acquisition be postponed until after exposure.

In another class of cases the exception is more apparent than real. Infants, newly born of variolous mothers, may

* Infants born of variolous mothers are sometimes insusceptible to vaccinia, and possibly the successful vaccination of the mother shortly before the birth of the child may have, occasionally, a similar effect. But there is reason to suppose that in either case the immunity conferred upon the child is fugitive.

develop smallpox even though vaccinated immediately after birth. This circumstance is due to the fact that the infection has been derived from the mother *in utero*. The rash in such cases is developed within ten days of birth, and the vaccination has in reality been done during the period of incubation.

Except by reason of accidental failure, vaccination can be performed successfully at any time during the greater part of the period of incubation. But after the onset of illness immunity develops rapidly, and after the efflorescence is completed the patient is wholly insusceptible to vaccinia. There is, however, a fallacy to beware of in determining the success of a vaccinal reaction when the operation has been done during the period of incubation. The irritation of the inoculation, even though the operation be unsuccessful, may be sufficient to evoke presently a small cluster of variolous vesicles over the seat of inoculation. The appearance produced is then very similar to that of a successful vaccinal reaction, and may be by no means easy to distinguish from it.

A chart is reproduced to show how immunity to vaccinia is acquired coincidently with the onset of an attack of smallpox.*

For its construction the records were collated of a large number of patients who suffered from smallpox, and had been vaccinated either during the period of incubation or during the first few days of the illness. The percentage of successful results was then plotted on verticals, corresponding to the intervals which elapsed between the dates of vaccination and of outcrop. (Chart XIV.)

From this chart it is clear that a very good final test against smallpox would be furnished by the successful vaccination of a patient with an eruption of doubtful character. If the eruption were three days old or more, the evidence might be regarded as conclusive. But it will be observed that a successful vaccination done on the day of outcrop would not be entirely convincing.

* Compiled from the hospital records by the author's former colleague, Dr. R. M. Freer.

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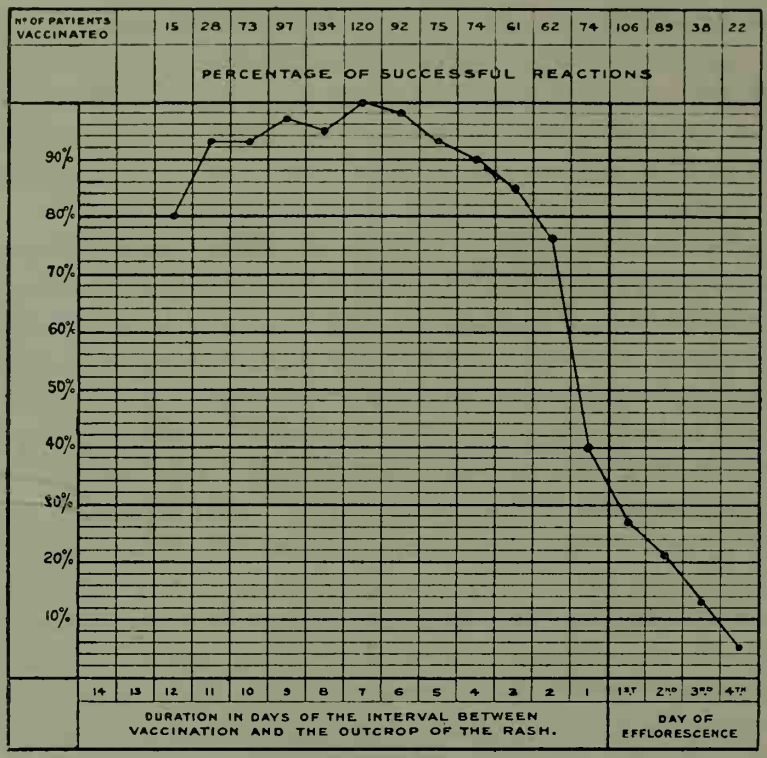
Nº OF PATIENTS VACCINATED
15 28 73 97 134 120 92 75 74 61 62 74 106 89 38 22
PERCENTAGE OF SUCCESSFUL REACTIONS
90%
80%
70%
60%
50%
40%
30%
20%
10%
14 13 12 11 10 9 8 7 6 5 4 3 2 1 1ST 2ND 3RD 4TH
DURATION IN DAYS OF THE INTERVAL BETWEEN VACCINATION AND THE OUTCROP OF THE RASH.
DAY OF EFFLORESCENCE

CHART XIV.—IMMUNITY TO VACCINIA ACQUIRED COINCIDENTLY WITH THE ONSET OF SMALLPOX.

The data used for the construction of the beginning and of the end of the chart are not completely accurate. Done during the first few days of the period of incubation, successful vaccination generally prevents the attack, and therefore would eliminate from the records the cases of persons so protected. In effect, the proportion of successful results among inoculations done during the first two-thirds of the period of incubation may be assumed to be uniform and to approach closely to one hundred per cent., the few unsuccessful results being due merely to accident. On the other hand, after the outcrop of the rash the percentage of successful results obtained was really much less than would appear from the chart. This fact is due to the circumstance that the records were not made for the purpose of these deductions. Unsuccessful vaccination after the outcrop, in an undoubted case of smallpox, is of no clinical interest, and in many cases the fact was not recorded. The line of susceptibility should fall near to the base-line on the first day of efflorescence, and become extinguished on the third. One successful reaction was recorded for the fourth day, but was open to question.

SMALLPOX AFTER A PREVIOUS ATTACK

A patient who has once had smallpox is generally insusceptible to a second attack. But second attacks are not rare,

though they are much more uncommon than reputed second attacks. Many patients with smallpox assert a previous attack, but furnish no evidence in support of the statement. In most of such cases the historical illness was probably chickenpox. Even when the patient is scarred, there is often no more than a presumption that the scars are variolous. When the evidence of the first attack is trustworthy, it will be found almost invariably that the interval between the two attacks has been a long one and that the second attack is mild. Instances in which a patient, displaying undoubted evidence of a previous attack, dies of confluent or of toxic smallpox are excessively rare.

If reputed second attacks are to be looked upon with a critical eye, what of relapses and recurrences? Many such are on record. But the burden of proof which is on the recorder is a little too lightly borne. Nature is not prodigal of her prodigies; and each of us may with confidence regard such an incident in his practice as furnishing presumptive evidence of one error of diagnosis.

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